# TEACHING GUIDE and ANSWER KEYS for the 12 BOOKS in the PATHWAYS IN SCIENCE SERIES

OXENHORN · IDELSON · GREENLEAF

S I METRIC EDITION

**BIOLOGY—1** *The Materials of Life*
**CHEMISTRY—1** *The Materials of Nature*
**EARTH SCIENCE—1** *The Earth We Live On*
**PHYSICS—1** *The Forces of Nature*

**BIOLOGY—2** *Built for Living*
**CHEMISTRY—2** *Chemistry of Mixtures*
**EARTH SCIENCE—2** *Oceans of Air and Water*
**PHYSICS—2** *Matter and Energy*

**BIOLOGY—3** *The Next Generation*
**CHEMISTRY—3** *Chemistry of Metals*
**EARTH SCIENCE—3** *Man and Energy in Space*
**PHYSICS—3** *Sound and Light*

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# PATHWAYS IN SCIENCE

## *A Complete Program for Underachievers in Junior and Senior High School*

**by Joseph M. Oxenhorn**
**and Michael N. Idelson**

## *A FLEXIBLE PROGRAM:*

**Vertical Plan**
Read down for a general science course using 4 texts.

**Horizontal Plan**
Read across for a course in one science area.

**Mix and Match Plan**
The books can be used in any order you prefer. Mix and match for a science program that meets your own students' needs!

| | | |
|---|---|---|
| **Biology—1**<br>The Materials of Life | **Biology—2**<br>Built for Living | **Biology—3**<br>The Next Generation |
| **Earth Science—1**<br>The Earth We Live On | **Earth Science—2**<br>Oceans of Air and Water | **Earth Science—3**<br>Man and Energy in Space |
| **Chemistry—1**<br>The Materials of Nature | **Chemistry—2**<br>Chemistry of Mixtures | **Chemistry—3**<br>Chemistry of Metals |
| **Physics—1**<br>The Forces of Nature | **Physics—2**<br>Matter and Energy | **Physics—3**<br>Sound and Light |

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# ABOUT THE BOOKS

## OVERVIEW OF THE PROGRAM

The *Pathways in Science* program for general science is a modern approach to develop *scientific literacy* and visual understandings for students in junior and senior high school. It is designed, especially, for the *underachievers* in our schools who, for a variety of reasons, have had limited success in academic subjects.

Concepts are developed in simplified language on a controlled reading level below the "average" grade level. The scientific vocabulary has also been sharply reduced to include only those technical words which are essential tools for comprehension.

Although the program aims to reach underachievers, *it is by no means a "watered-down" curriculum*. The curriculum is fairly standard. The scientific concepts are fully developed. The spirit and process of scientific inquiry are treated effectively. The program can best be described as *"standard-enriched-simplified."*

This program is entirely appropriate for the average, as well as for the students with learning problems.

## COMPONENTS OF THE PROGRAM

The *Pathways in Science* series consists of 12 books which provide a flexible science program. Under ideal conditions, each of the books can be bracketed for approximately nine weeks duration, making a total of four books per school year. Under practical considerations, while the four books are being used, the teacher can use the material *selectively*. Thus students will be exposed to the total suggested program, though perhaps not "finishing" each book.

The 12 books can be used to teach a general science course (vertical plan) or to teach a course in one science area (horizontal plan). In addition, you can "mix and match" the books for a program that best suits your special needs and teaching preferences.

↓ VERTICAL PLAN

HORIZONTAL PLAN →

| | | |
|---|---|---|
| Biology–1 | Biology–2 | Biology–3 |
| Earth Science–1 | Earth Science–2 | Earth Science–3 |
| Chemistry–1 | Chemistry–2 | Chemistry–3 |
| Physics–1 | Physics–2 | Physics–3 |

| BOOK 1 SERIES | BOOK 2 SERIES | BOOK 3 SERIES |
|---|---|---|
| **Earth Science—1** | **Earth Science—2** | **Earth Science—3** |
| The Earth We Live On | Oceans of Air and Water | Man and Energy in Space |
| **Chemistry—1** | **Chemistry—2** | **Chemistry—3** |
| The Materials of Nature | Chemistry of Mixtures | Chemistry of Metals |
| **Physics—1** | **Physics—2** | **Physics—3** |
| The Forces of Nature | Matter and Energy | Sound and Light |
| **Biology—1** | **Biology—2** | **Biology—3** |
| The Materials of Life | Built for Living | The Next Generation |

## ORGANIZATION OF THE BOOKS

### 1. TEXT AND ILLUSTRATIONS

Each book is divided into a number of *Units*, each of which is followed by a *Glossary*. Each Unit is divided into *Chapters*, and every Chapter is headed by a *Target*, which provides the aim of that Chapter in the form of a simple concept question. Each Chapter in turn is divided into *Paragraphs*. Paragraphs are numbered for easy reference.

Illustrative material includes

1. photographs.
2. artists' renditions.
3. graphs.
4. charts.
5. diagrams.
6. pictographs.

Many of these are in full color. Each illustration is numbered for easy reference and is accompanied by an explanatory caption.

### 2. EXPERIMENTS AND DEMONSTRATIONS

There are numerous student experiments and teacher demonstrations included in the text. They are titled *Do And Discover.* Many of these contain explanatory illustrations. All of them can be easily followed, and many can be used as laboratory work-guides. The approach to these experiments (investigations) is a carefully balanced compromise between "open end," process-of-inquiry approach and the more structured development. The approach takes into account the student by providing guidance and some answers. At the same time, there is room left for students to do their own observing, their own modification, and drawing their own conclusions. In this compromise technique, the aim is to keep encouragement open, while providing for a realization of success.

### 3. END-OF-CHAPTER EXERCISES

At the end of each Chapter there are exercises entitled *Understanding What You Have Read* which contain both thought-provoking and factual questions. They are designed to strengthen reading skills as well as test the students' grasp of the subject matter. These include:

1. *What Are the Two Main Ideas in This Chapter?* Designed to improve student's ability to get the gist of the reading.
2. *In Which Paragraph Do You Find the Answer?* A test of the student's ability to locate facts and to read with comprehension.

3. *Knowing What and Why.* Factual and judgment questions in multiple choice form.
4. *What Does the Experiment Prove?* A test of the student's ability to discern the objective of an experiment.
5. *True or False?* A test of the student's ability to distinguish between what is correct and what may appear to be correct.
6. *Number, Please.* A test of the student's grasp of essential numerical facts and mathematical skills related to the chapter.
7. *On the Ladder of Understanding.* A periodic review of previous Chapters, Units and even Sections.
8. *For the Home Scientist.* Suggestions for projects and experiments related to material in the chapter; sources of free science materials.
9. *Unscramble the Words.* A word game involving words with scrambled letters. The solutions bring delightful answers: baseball players, presidents, and so forth.
10. *For the Amateur Scientist.* Interesting science projects that students can pursue outside the classroom.

## 4. SPECIAL FEATURES

1. *You Now Know*—Medial summaries that review and fix learnings.
2. *Glossary: What Does It Mean?*—A list of words at the end of each unit, containing the phonetic pronunciations and spellings and simplified meanings of terms used in that unit.
3. *Try This Problem*—Simple arithmetical problems with sample solutions.
4. *Vocabulary Aids*—All new scientific words are in the text accompanied by simplified phonetic spellings to teach pronunciation. Examples: *laboratory* (LAB-ra-TOR-ee); *mercury* (MUR-kue-ree). The accent is on the capitalized letters.
5. *Occupational Motivations*—Recognizing that many of the students who use this text will turn to "blue-collar" or service trades, we encourage them by suggesting possible occupations.

   Examples:
   - Would you like to be an electrician?
   - Wanted: Ignition Expert.
   - Would you like to wire houses?
   - Laboratory technicians do interesting work.
6. *College Incentive*—Although these students are retarded in reading, we leave the door open for later development. We stress the need for more schooling.
7. *Profiles of Great Scientists*—These brief, anecdotal biographies are designed to be inspirational as well as informative. In sum, the students are made aware that the scientists have been drawn from among many types of people: they were people with "human" qualities.

## 5. TEACHING THE STUDENTS HOW TO USE THE BOOKS

It is imperative that *early* in the year students be taught the organization of their books and how to use them. *The book is a tool* and its proper use will help the student learn more easily.

The following procedure is suggested:

1. Discuss the title *Pathways in Science.* What does it mean? A pathway is a road, a street or an avenue that leads somewhere. In this course, students will travel along pathways toward a greater understanding of science.

2. Show the students the various books in the series. Ask them to read the titles. Introduce and define the four major areas of science: Chemistry, Physics, Biology and Earth Science.
3. Show the students the *Table of Contents*. Explain its use. Ask the students to choose ten topics from the Table of Contents and to turn to the page reference in order to demonstrate the usefulness of this part of the book.
4. Show the *Index*. Explain how it differs from the Table of Contents. Discuss the meaning of "alphabetical order." Ask the students to locate ten items in the Index and the pages in the text on which they appear.
5. Show the students the *Glossaries*. Explain their usefulness and encourage the students to refer to them often. Drill the use of phonetic pronunciations.
6. Show the students the *Units* in each Section and discuss the reasons for dividing each Section in this manner.
7. Show that each Unit has a number of *Chapters*. Have the students locate several Chapters and discuss their titles.
8. Point out that each Chapter has a *Target*. Discuss the meaning of the term "target" and stress that the text will answer the Target question.
9. Show that each Chapter is divided into *Paragraphs* and point out the usefulness of arabic numbers for easy reference.
10. Show the students the medial summaries (*You Now Know*). Point out that each one contains one or two ideas and that these may be used for review and for self-tests.
11. Look at some of the illustrations with the students. Show them how to understand the numbering system for the illustrations. Example: Fig. 23-1 refers to the first illustration on page 23.

# MODEL LESSON PLANS

THE LESSON PLAN BELONGS TO THE TEACHER! IT SUITS THE TEACHER'S NEEDS. IT IS FLEXIBLE. ITS FORMAT VARIES FROM TEACHER TO TEACHER. THE FOLLOWING MODEL PLANS ARE SUBMITTED AS SAMPLES ONLY. SINCE THEY ARE DESIGNED AS SAMPLES, THEY ARE GENERALIZED.

## I. DEMONSTRATION-RECITATION LESSONS (CHEMISTRY)

This type of lesson has a central concept which is developed through proper demonstration, usually by the teacher, and with the assistance of the pupils. The emphasis is on careful observation and logically drawn conclusions. The teacher, through skillful questioning, leads the students to an understanding of the concept. The students take notes and draw conclusions. Homework includes the use of the textbook.

BOOK REFERENCE: *Materials in Nature* (Chemistry I), Unit II, Chapter 6, p. 38.

### AIM:

To show that water is a compound.

### MOTIVATION:

The ancients believed that all matter consisted of four elements: earth, air, fire and water. Is water really an element? If it is, then it cannot be broken up into simpler substances. Today, we shall see how the scientist answers such a question and how the scientist learns that water can be broken up into simpler substances.

### CONCEPTS TO BE DEVELOPED:

1. An element cannot be broken into simpler substances.
2. A compound consists of at least two different elements.
3. The properties of a compound are very different from the properties of the elements in it.

### DEMONSTRATIONS:

Hoffman's apparatus (Fig. 39–1) is set up. The apparatus is filled with a dilute solution of sulfuric acid. To assure visibility, the water is colored red with a few drops of red ink. The stopcocks in each tube are closed after allowing the solution to reach the top of the tube. A storage battery is connected to the electrodes at the bottom of each tube. Allow the current to flow until 20 to 30 cc of hydrogen is collected. After allowing the gas to pass into a test tube by opening the stopcock, test for oxygen using a glowing splint. Open the second stopcock, allowing the gas to pass into a test tube. Test for hydrogen by using the "pop" test.

PREPARATION OF CLASS:

For previous day's homework, have students read Chapter 6.

DEVELOPMENT AND QUESTIONS:

1. The terms *element* and *compound* are defined.
2. Discuss how we prove that water is not an element. Have students describe the demonstration.
3. Call attention to the fact that water is evidently being replaced with some other kind of matter in each tube. Have a student read the volume of gas collected in each tube.
4. Raise question of how to identify the gases in each tube. After a discussion, allow the gases to flow into test tubes held above the stopcocks. The identity of the gases can be established with the glowing splint and "pop" tests. Have the class make the observation that the two gases are different; they are formed at different rates, in different amounts and they respond differently when tested. Inform the class that one of the gases is hydrogen and the other is oxygen. Point out that careful tests have shown that the amount of sulfuric acid at the end of the test is the same as it was at the beginning of the experiment; the amount of water, however, is less.

SUMMARY AND NOTES:

1. Have students state the conclusions to be drawn from the demonstration. These are put on the board.
2. Have students copy these conclusions and the diagram of the set-up into their notebooks.

HOMEWORK:

Review Chapter 6. Answer Questions I–VII.

## II. STUDENT-LABORATORY LESSONS (BIOLOGY)

Student-laboratory lessons take the "mystery" out of science. They provide opportunities for self-discovery. They develop manipulative skill and build self-confidence.

Laboratory lessons must be well-organized and carefully planned ahead of time. The teacher should divide the class into work groups of two to four students, familiarize the class with the necessary safety precautions, and if possible, prepare lab sheets for the students to follow, supplementing them with oral instructions during the lesson. Home apparatus should be used whenever possible. Circulate about the room during the lesson to help the various groups. Allow quiet conversation and an informal "shop" atmosphere. Stop all work in time for clean-up and summary.

BOOK REFERENCE: *Built for Living* (Biology 2), Unit III, Chapter 11, p. 67.

AIM:

To learn what your pulse tells you about your heart.

MOTIVATION:

"When someone is sick why does the doctor take his pulse?"

CONCEPTS TO BE DEVELOPED:

1. A pulse results from the pumping of the blood through the arteries by the heart.
2. Pulse rates vary from person to person.
3. Pulse rate depends upon a person's activity.

PREPARATION OF CLASS:

1. The class has read Chapter 11.
2. The class has reviewed the definition and functions of the blood.

PROCEDURE:

1. Distribute lab sheets and materials to all groups.
2. Review procedures.
3. Allow the students to proceed with work. Have them take notes on their observations as they go.
4. Stop all work.
5. Clean-up and summary.

HOMEWORK:

1. Review Paragraphs 1 and 2 in Chapter 11.
2. "At home compare the pulse rate of your mother and father with your brother, sister or yourself."

## SAMPLE LAB SHEET

Pupil's Name____________________________Class______________________

AIM:

To discover what our pulse means.

MATERIALS (for each group):

1. Stopwatch.
2. Stethoscope (if necessary make a simple stethoscope using a funnel and rubber tubing).
3. Pencil and paper.

PROCEDURE:

1. Students take their own pulse for one minute. This is done by placing the first and second fingers of the right hand over the artery which lies close to the surface of the left wrist.
2. Then students will listen to their heartbeats using the stethoscope. They will count their heartbeats for one minute.
3. One student from each group will jump up and down 25 times. One student will then take his/her pulse while another student times his/her heartbeats for one minute.

4. Record the results on the chart below:

| At Rest | | After Jumping | | Check Proper Column | |
|---|---|---|---|---|---|
| Pulse rate per minute | Heartbeats per minute | Pulse rate per minute | Heartbeats per minute | Boy | Girl |
| | | | | | |

CONCLUSION:

1. What is the connection between heartbeat and pulse rate?
2. Why does the pulse rate increase after exercise?
3. Who has a faster pulse rate, a boy or a girl?

## III. THE SUPERVISED STUDY-READING LESSON (EARTH SCIENCE)

A supervised study lesson is an effective teaching technique with two general aims: to gain mastery of the subject matter and to improve reading skills. This type of lesson is not a free reading period; it is fully supervised, controlled and teacher-guided. Thus, the teacher is active at all times. Whatever disrepute supervised study lessons have fallen into has been the result of teacher inactivity and the doling out of assignments on a "busy work" basis. Such classes, unless bulldozed into silence and obedience, quickly develop disciplinary problems. Teacher activities in the supervised study lesson should include supervising group and individual work, exhibiting visual aids, checking, guiding, correcting, and summarizing. Concomitant learnings in such lessons include the development of good work habits, research skills, self-discipline, and organized study habits.

The teacher should have in mind a specific aim for every supervised study lesson. For example: "What are some of the ways in which mountains are formed?" "What is the purpose of a topographic map?" "How is glass made?" This aim should be both stated to the pupils and written on the board.

Omitting a motivation in the supervised study lesson, or in any lesson for that matter, often results in a lethargic pupil response. The motivation should be clearly relevant to both the lesson and to the pupils' own lives and activities.

BOOK REFERENCE: *The Earth We live On* (Earth Science 1), Unit II, Chapter 13, p. 78.

AIM:

To learn how volcanoes are formed.

MOTIVATION:

Read p. 78 aloud to the class and direct the students' attention to the photograph of Stromboli in Fig. 78-1. Discuss the myth of Vulcan. ("Does it seem reasonable to you that volcanoes are made in this way?" "Why did the Greeks believe that Vulcan made volcanoes?" "How do you think volcanoes are made?" "Let's read the rest of the chapter to find out.") Write the chapter title on the board and discuss how that might offer a clue as to how volcanoes are formed.

CONCEPTS TO BE DEVELOPED:

1. The mythological explanation of the formation of volcanoes is very different from the scientific explanation.
2. Volcanoes are caused by the eruption of magma from inside the earth.
3. There are three kinds of volcanoes: quiet, intermediate, and explosive.

PREPARATION OF CLASS:

1. "Clear your desks of everything, please."
2. "Open your books to p. 78."

DEVELOPMENT:

1. Read the Target Question. Discuss the difference between *myth* and *science*. Discuss possible explanations for the formation of volcanoes.
2. Have the students read paragraph 2 silently to themselves. Discuss the paragraph. Draw a diagram of a volcano on the board and have students label the parts and explain their function.
3. Have the students read paragraph 3 silently to themselves. Discuss the paragraph. Have students change the drawing on the board to a quiet, intermediate and explosive volcano.
4. Have the students read paragraph 4 silently to themselves. Discuss the paragraph. "What do you think the people of Pompeii thought when they saw the volcano erupt? Remember that they didn't know the scientific explanation for volcanoes." Elicit from the students the idea that it is reasonable that the Greeks would invent Vulcan to explain volcanoes, since they had little scientific knowledge.
5. Have the students read paragraph 5 silently to themselves. Discuss the paragraph. "How does the birth of a new volcano in modern times help to improve the scientific explanation of volcanoes?"
6. Help students to locate on a map of the world the volcanoes mentioned in paragraph 6.

SUMMARY:

1. "Take out your notebooks. Place the date at the top of a clean page. Write the chapter title (from the board) and page number (from the book)."
2. Using a plaster of Paris model of a volcano, help students to reword each point in *You Now Know* on page 81 and have them copy these points into their notebooks.

HOMEWORK:

1. "Answer Questions I, II, III, and IV in *Understanding What You Have Read*, page 82."
2. Ask for volunteers to do V and VI for extra credit.

## IV. THE VISUAL-AID TYPE SCIENCE LESSON (PHYSICS)

1. Science teaching, since it utilizes apparatus, probably stands at the top of the list among curriculum areas in the use of visual aids. Projected visual aids—films and filmstrips—serve to reinforce learnings.
2. Applications:
   Films and filmstrips can be used as follows:
   a. to introduce a new unit.
   b. to summarize a unit.
   c. to extend experience beyond classroom possibility. For example, a film illustrating the production of iron by the blast furnace.
   d. to reinforce a part of a lesson—e.g., slides or a film showing the operation of a power plant, its generators and the way in which water is used as a source of energy.
   e. It is often necessary for a teacher to use a film or filmstrip *selectively* as to the specific frames, rather than to use the film in its entirety. The reason for this obviously is that the film does not always follow the specific textbook or the specific syllabus. Thus, it is imperative that the teacher *preview* the film and know exactly which frames to use and which ones to skip.
3. Hints on Visual Aids:
   a. *Always* preview the film or filmstrip.
   b. Read the study guide which is often supplied by the producer.
   c. Prepare the class with
      motivation
      purpose of the viewing
      points to look for
      new words.
   d. Make certain the equipment is in good working order.
4. Summary:
   Allow time for an oral summary and notes.

BOOK REFERENCE: *Sound and Light* (Physics 3), Unit III, Chapters 4 and 5.

AIM:

To review the laws of reflection.
To show how images are formed in mirrors.

FILM:

*Light: Reflection* (13½ min. Coronet Instructional Films).

DEVELOPMENT:

1. The class has been prepared by studying and reviewing chapters 4 and 5 in Unit III.
2. "Today we shall watch a film together. The film will help you understand the process by which light behaves as it forms images in mirrors."
3. Show the film, making any commentary that appears to be needed. If necessary, the film should be stopped to discuss any points that need additional clarification.

SUMMARY:

1. At the conclusion, discuss the film. From this discussion, have the class develop a summary. Write the main points of the summary on the chalkboard.
2. If you wish, have the students copy the summary into their notebooks.

## V. REVIEW AND DRILL LESSONS

Review and drill, the extensions of learning, are extremely important with underachievers. Review and drill are based on sound principles of psychology. Reviewing is not a caboose to learning. It *is* learning. Review and drill are related and are often confused as identical. Review is a *re*-view: a second, third or fourth look. Drill aims for mastery through automatic response. THE AIM OR PURPOSE OF THE REVIEW MUST ALWAYS BE MADE CLEAR TO THE STUDENTS AT THE START.

TYPES AND TECHNIQUES:

1. *Notebook Review*—Students and teacher cooperatively re-read the notes of a given topic. Discussion. Questions. Reinforce with pupil board work. Drill spelling.
2. *Textbook Review*—Review a chapter, its parts, its *You Now Know*, its end-of-chapter exercises, its illustrations. Drill spelling. Have charts on board for review.
3. *Oral Review*—The teacher assigns topics (on board or on 3 X 5 file cards). Students "research" answers in notebook and textbook. Students interchange their results in discussion. Reinforce with board work.
4. *Visual Aid Review*—Show a film or slides to review selected topic. Stop film frequently. Ask questions. Discuss.
5. *Practice Tests*—Distribute practice test. Work cooperatively with students to select answers. Discuss choices. Review old tests already taken.

*NOTE:* A very effective technique is to combine at least two or more of the listed techniques during a given period.

SPECIAL EMPHASIS FOR UNDERACHIEVERS:

Emphasize simple definitions.

Emphasize spelling of scientific words.

*Individualize*. Not all students need to be reviewing. While the teacher reviews with a small group, others can do advanced reading or enrichment reading.

## VI. FIELD TRIP PLAN (BIOLOGY)

Field trip lessons require long-range planning to include legal clearance, safety, permissions, collections of materials, and a follow up. The sample lesson described below is for an actual *field* trip. In general, it can be modified to apply to a museum, factory, or laboratory trip. The lesson plan presumes at least one preparatory lesson.

## AIM:

To find what common plants and animals live in and near "Perkins Pond."

## MATERIALS:

Knap-sacks, vascula, small corrugated cartons, insect nets, insect killing bottles, storage jars, pruning sheers, pocket knives, alcohol jars, water jars, formaldehyde jars, dip nets, magnifying glasses, field glasses, simple guide to birds, simple guide to trees and shrubs, guide sheet to Perkins Pond field trip, notebooks. (Optional: pupils' cameras)

## PROCEDURES:

1. Assembly and roll call in school. Announce time restrictions.
2. Distribution of materials
3. Transportation
4. Collection and temporary preservation (Guide sheets list materials to be collected and tell how to collect them.)
5. Reassembly–roll call
6. Check materials
7. Transportation to school
8. Allow time for temporary storage; collect materials.
9. Roll call; dismissal

*NOTE:* Where applicable, a lunch break has been blocked in at a convenient time.

## GUIDE SHEET:

*FIELD TRIP GUIDE SHEET NO. 3* *PERKINS POND*

LAST NAME______________FIRST______________SECTION______________

1. Make the following observations:
   1.1 Estimate the size of the pond (length, width, area).
   1.2 How can you tell how deep it is?
   1.3 Is the shore line regular or irregular?
   1.4 Is the edge muddy or hard?
   1.5 Estimate the height of the tallest trees.
   1.6 Are there any dead trees around?
2. Identify:
   2.1 The maple tree. Draw a leaf.
   2.2 The Staghorn sumac. Draw a branch.
   2.3 The water birds.
   2.4 Any three other birds.
   2.5 The fallen tree dipping into the pond.
   2.6 The bugs in the bark of the fallen tree.
   2.7 The moss near the "No Swimming" sign.
   2.8 The Boston Ferns.
   2.9 Three insects.
3. You will be required to collect seven (7) of the following. You may collect more of each, or all ten.
   3.1 Two flying insects
   3.2 Two crawling insects
   3.3 A sample of clear pond water

3.4 A scoop of bottom pond water
3.5 A sample of the floating alga
3.6 Six different kinds of leaves
3.7 A small branch of two different shrubs (sample for the group)
3.8 A small branch of two different trees (sample for the group)
3.9 Two different flowers
3.10 Two different fruits.

CAUTIONS:

Keep your materials together.

Stay close to your group.

If you hurt yourself, tell your group leader at once.

Someone in the group must notify the teacher at once.

We meet again at ________ (A.M., P.M.). We leave Perkins Pond at ________ (A.M., P.M.). We expect to be back in school at about ________ (A.M., P.M.).

FOLLOW-UP:

Every trip should have one or more follow-up lessons. Part of the follow-up will be *activity* and part *discussion.*

Activity is needed for arranging, classifying, preserving and describing collected materials. The guide sheets should be evaluated by the teacher. A follow-up lesson may also include an audio-visual lesson. A long-term follow-up might include a bulletin board or showcase exhibit.

Discussion follow-up includes:

. . . discussion, comparison of data, summation.
. . . review of answers to guide sheets.
. . . class representatives to write courtesy letter to facility.
. . . class representatives to prepare "news release" for school newspaper.
. . . evaluation of trip for improvement.

[illegible]

[illegible] two different [illegible] for the [illegible]
[illegible] of two [illegible] for the group.

Two field [illegible]

[illegible]

Keep your notes all [illegible]

Stay close to your group.

If you have [illegible] tell your group leader.

Someone in the group must [illegible]

We [illegible]

[illegible]. We expect to be back [illegible]

[illegible]

Discovery [illegible]

activity and [illegible]

Activity [illegible]

[illegible]

including [illegible]

showcase [illegible]

Discussion [illegible]

[illegible]

[illegible] The children [illegible]

The [illegible] of the [illegible]

The [illegible]

# ANSWERS TO TEXT QUESTIONS
# BOOK 1 SERIES

# BIOLOGY 1—THE MATERIALS OF LIFE

**UNIT I: Chapter 1**

**I.** 1, 3 **II.** 1-3, 2-6, 3-3, 4-6 **III.** 1-a, 2-b, 3-d, 4-a

**Chapter 2**

**I.** 2, 3 **II.** 1. Your sense of touch enables you to distinguish one living thing from another by noting their texture. 2. Notes help them to remember what they have seen or heard. 3. We have 5 senses. 4. He keeps notes and records of his work in and out of class. **III.** 1-a, 2-d, 3-a, 4-c **IV.** 1. a. This will enable one to study the sounds a cricket makes under different conditions. b. Slow-motion pictures could enable one to study the movements of bees in their building processes. c. Can be set up to go off when an eagle feeds its young in its nest. d. You can catch certain birds and feel their feathers. e. Time the intervals between croaks. 2. a. You can note the progress that is taking place. b. The depth of the redness, the sweetness of the taste and the weight are important factors in comparing one kind of strawberry with another.

**Chapter 3**

**I.** 1. Biology is the study of living things. Ecology is the study of the relationship of one living thing to all living things. 2. Biosphere is the water, land and air in which living things are found. Atmosphere is the envelope of air surrounding the earth. 3. Marine water = salt water biome of oceans, seas, bays. Fresh water = lakes, ponds and rivers. 4. A naturalist is one who studies living things in all their biomes. Astronauts are space explorers. **II.** 1. They visit all the biomes. 2. So that future space travel will be easier and more safe. 3. Bones and fossils of plants and animals that inhabited the earth a long time ago. 4. They go below sea level in bathyscaphes. **III.** 1-b, 2-c, 3-d, 4-d **IV.** 1-c, 2-b, 3-a, 4-d

**Chapter 4**

**I.** 2, 4 **II.** 1. By placing the correct number of plants and animals in the aquarium 2. We eat the stem of the onion plant. 3. By following the directions to the experiments described on pp. 25-26 4. By making cuttings, slicing a potatoe with many "eyes," etc. **III.** 1-d, 2-d, 3-a, 4-c **IV.** 1-c (spores), 2-a (cuttings), 3-f (root), 4-b (hamsters), 5-b, e

**Chapter 5**

**I.** 2, 5 **II.** 1-4, 2-6, 3-7, 4-5 **III.** 1-a, 2-c, 3-a, c, d, 4-b **IV.** 1-e, 2-d, 3-b, 4-c, 5-f **V.** 1. isotope 2. limewater 3. C, O

**UNIT II: Chapter 6**

**I.** 2, 4 **II.** 1-3, 2-5, 3-4, 4-2 **III.** 1-b, 2-b, 3-c, 4-a

**Chapter 7**

**I.** 2, 4 **II.** 1. It is called a stimulus. 2. Some people's color becomes paler. 3. Plants respond to changes in their environment. 4. When it gets cold, the pores of the skin close up suddenly and cause the "goose pimples." 5. Our sense organs receive stimuli. **III.** 1-a, 2-a, 3-a, 4-a **IV.** 1. a-stimulus, b-stimulus, c-response, d-stimulus, e-response, f-response, g-response, h-response, i-response, j-stimulus 2. c-water, e-excess cold or fear, f-danger, g-need for sunlight, h-fear, i-sound of danger **V.** 1. useful 2. cold 3. response

**Chapter 8**

**I.** 1, 4 **II.** 1-3, 2-4, 3-3, 4-4 **III.** 1-c, 2-d, 3-b, 4-b **IV.** 1. Ingestion is the intake of food into an organism. Chewing is the process of making food smaller so that it can be digested more easily. 2. Famine is a period of great shortage of food for a great number of people. Starvation is suffering from hunger. 3. Fertilizers are mixtures of chemicals added to soil to replace minerals that plants have used up. Soil water is water in which minerals are dissolved that are absorbed by plant roots.

**Chapter 9**

**I.** 1, 3 **II.** 1-4, 2-3, 3-6, 4-1, 2, 5-2 **III.** 1-a, 2-a, 3-c, 4-d **IV.** 1. atoms 2. compounds 3. response 4. cold 5. element

**Chapter 10**

**I.** 1, 3 **II.** 1-4, 2-3, 3-1, 4-2 **III.** 1-a, 2-c, 3-d, 4-c **IV.** 1. ingestion 2. excretion 3. oxidation 4. stimulus **V.** 1. Your hands perspire and the perspiration cannot be evaporated into the air because of the rubber gloves. 2. They close up the pores in the face and prevent the wastes in perspiration from being removed from the face. **VI.** 1. oxidize 2. breathing 3. oxygen 4. carbon dioxide 5. water vapor 6. spiracles 7. nostrils 8. windpipe

**Chapter 11**

**I.** 2, 4 **II.** 1. The food one eats is turned into living matter which is used to repair cuts. 2. The process of assimilation turns food to flesh and bones. 3. The chemical calcium is needed to form bones. 4. By the process of assimilation **III.** 1-b, 2-c, 3-d, 4-a **V.** 1. elements 2. chemical 3. elements 4. oxidation or combustion 5. carbon dioxide

**Chapter 12**
**I.** 2, 4 **II.** 1. The number of offspring are greater than the number of parents. 2. It is the way living things can "live forever." 3. They "shoot out" spores or seeds. 4. Humans have found ways to check disease. **III.** 1-b, 2-d, 3-c, 4-a **IV.** 1-f, 2-d, 3-b, 4-a, 5-c, 6-e, 7-g **V.** 1. breathing 2. reproducing 3. excreting 4. assimilating 5. digesting: B R E A D

**UNIT III: Chapter 13**
**I.** 2, 4 **II.** 1-2, 2-3, 3-6, 4-5 **III.** 1-b, 2-a, 3-b, 4-d **IV.** 1-e, 2-f, 3-b, 4-d, 5-c, 6-a **V.** 1. 120X 2. 350X

**Chapter 14**
**I.** 2, 4 **II.** 1-3, 2-4, 3-4 (chart), 4-4 (chart), 5-1 **III.** 1-b, 2-a, 3-d, 4-c, 5-b **IV.** 1-d, 2-a, 3-b, 4-e, 5-c

**Chapter 15**
**I.** 1, 4 **II.** 1-2, 2-4, 3-3, 4-4, 5-3 **III.** 1-c, 2-a, 3-b, 4-c **IV.** 1. definite shape 2. protoplasm (living matter) 3. nucleus 4. green

**Chapter 16**
**I.** 1, 2 **II.** 1. The cell membrane 2. It is a mixture of compounds and elements. 3. The amount of sugar or oxygen in it depends on various changes in digestion or respiration. 4. The nucleus or the heart and brain of the cell 5. The cellulose or cell wall of plants is lifeless. **III.** 1-c, 2-b, 3-b, 4-a **IV.** 1. $H_2O$, 80% 2. oxygen, 65% 3. 3% 4. under 3%

**Chapter 17**
**I.** 1, 4 **II.** 1-3, 2-6, 3-4, 4-2, 5-5 **III.** 1-a, 2-d, 3-c, 4-b **IV.** 1-b, 2-e, 3-a, 4-c, 5-c **V.** 1. elements 2. growth 3. membrane 4. stimulus

**Chapter 18**
**I.** 1, 3 **II.** 1. The nervous system which ends in sight, smell, hearing, taste and touch 2. One way, if it is from loss of blood, is to give the victim a blood transfusion. 3. The platelets give off a chemical that causes the blood to clot at the wound. 4. Pus is made up of dead white blood cells and dead germs. 5. In order to put new blood into the body of a person who has lost a lot of blood **III.** 1-b, 2-a, 3-d, 4-a **IV.** 1. red 2. white 3. white 4. plasma 5. water 6. 5 L 7. white 8. neurons **V.** 1. True 2. True 3. Platelets 4. True **VI.** 1. iron and oxygen 2. salt 3. cell membrane 4. $H_2O$

**Chapter 19**
**I.** 1, 4 **II.** 1-4, 2-3, 3-4, 4-2, 5-4 **III.** 1-c, 2-c, 3-a, 4-c **IV.** 1. tissues 2. organs 3. breathing 4. cell **V.** 1. The vaseline will plug up the stomates through which the plant gets its oxygen. 2. Yes; usually all have a major tissue plus blood or nerve or muscle tissue to help the organ operate. 3. Nerve tissue, blood tissue and muscle tissue. The blood tissue supplies the windpipe with the necessary food. The nerve tissue gives the proper response for its (windpipe) operation. The muscle tissue helps in its (windpipe) movements.

**UNIT IV: Chapter 20**
**I.** 2, 4 **II.** 1. The energy from sunlight is needed for photosynthesis. 2. They store this extra food in their roots, stems, leaves, fruits, and seeds. 3. The raw materials needed for photosynthesis are $CO_2$ and $H_2O$. 4. Animals get their food from plants or other animals. **III.** 1-a, 2-d, 3-c, 4-b **IV.** 1-d, 2-e, 3-b, 4-d, 5-c, 6-c, 7-c, 8-a, 9-a **V.** b-g-a-f-c-d-e

**Chapter 21**
**I.** 1, 2 **II.** 1-3, 2-6, 3-4, 4-6 **III.** 1-c, 2-a, 3-c, 4-a **IV.** 1-e, 2-a, 3-d, 4-b & c, 5-b **V.** 1. eating, digesting, circulating, excreting 2. breathing, respiration, oxidation, sweating **VI.** 1. There is less oxygen in the air on a mountain top and people have to work harder to get sufficient oxygen. 2. When one exhales, the moisture in the exhaled air condenses on the lenses and becomes water. This water is an aid in cleaning the lenses. **VII.** 1. There is less oxygen in the air on high mountains, so the natives need larger chests and lungs to take in more air so as to extract as much oxygen as possible. 2. The need for oxygen is just as great on the mountains as it is on the plains. 3. The extra 2 L(litres) of blood are needed to get the small amounts of oxygen circulating to all the cells of the person.

**Chapter 22**
**I.** 1, 4 **II.** 1-2, 2-3, 3-5, 4-8 **III.** 1-b, 2-b, 3-b, 4-a **IV.** duck - oyster - fish eggs - kidney - cream cheese **VI.** 1. carbohydrate 2. assimilation 3. sodium 4. seafood 5. ingestion 6. urea 7. sugar: C A S S I U S

**Chapter 23**
**I.** 2, 3 **II.** 1. compounds of iron, calcium, sodium and iodine 2. oil (fat) and minerals 3. Yes! All foods have water. 4. carbon, hydrogen, and oxygen **III.** 1-c, 2-a, 3-c, 4-b **IV.** 1-c, 2-d, 3-a, 4-b **V.** nutrients - tests - color change - six compounds - carbohydrates

**Chapter 24**
**I.** 1, 3 **II.** 1-2, 2-3, 3-4, 4-6, 5-4 **III.** 1-a, 2-d, 3-c, 4-c **IV.** 1-d, 2-a, 3-c, 4-g, 5-b, 6-e, 7-f

**Chapter 25**
**I.** 1, 3 **II.** 1. Teenagers need 11 800 kJ for girls and 13 500 kJ for boys. 2. Tea has no food value; soda has sugar. 3. They are stored as

fat. 4. Gram for gram, sweet foods and fats have more kilojoules than protein and starches. **III.** 1-b, 2-c, 3-d, 4-b **IV.** 1-295, 295, 420, 315, 420, 715; Total: 2460 kJ 2-420, 420, 315, 315, 670, 715; Total: 2855 kJ **V.** heat - nutrient - digestion - oxidized - respiration - fats - sugar

**Chapter 26**

**I.** 1, 3 **II.** 1. Foods rich in iron 2. Foods rich in starch, sugar or fat 3. It depends on the size and frame of the person. 4. This is a balanced diet. **III.** 1-b, 2-d, 3-a, 4-c **IV.** 1-d, 2-e, 3-b, 4-c, 5-a **V.** protein - allergy - insulin - nitrogen: PAIN

# EARTH SCIENCE 1—THE EARTH WE LIVE ON

### UNIT I: Chapter 1

**I.** 1, 2 **II.** 1. The waters of the earth are called the Hydrosphere. 2. The crust of the earth is 30 km thick. 3. The Iron Age followed the Bronze Age. 4. Boring tests tell us about the composition of the inside of the earth. **III.** 1-b, 2-c, 3-d, 4-a **IV.** Bronze Age-5000 years ago, Iron Age-4000 years ago, Stone Age-1,000,000 years ago. **VI.** 1. The study of the moon's rocks show them to be of the same age as the earth and some scientists believe both the earth and moon were formed at the same time. 2. Oceanography is a specialized branch of geology. 3. He had to extract the metals from their ores and learn how to shape them into the tools he needed. 4. The basic difference is that a continent is a great deal larger than an island.

### Chapter 2

**I.** 1, 4 **II.** 1-2, 2-3, 3-6, 4-7 **III.** 1-d, 2-b, 3-b, 4-c **IV.** 1. mixture 2. compound 3. elements 4. respiration 5. oxygen. **VI.** 1. Si-silicon, O-oxygen 2. Al-aluminum, O-oxygen 3. Fe-iron, O-oxygen 4. Ca-calcium, O-oxygen 5. Mg-magnesium, O-oxygen 6. Ca-calcium, Si-silicon, O-oxygen. **VII.** 1. a safety device to prevent burning the hands 2. pyrex 3. a wooden stand 4. you get the same results.

### Chapter 3

**I.** 2, 4 **II.** 1-1, 2-2, 3-4, 4-3 **III.** 1-a, 2-c, 3-d, 4-c **IV.** 1. boulders 2. minerals or crystals 3. magma 4. igneous 5. different rates of cooling magma.

### Chapter 4

**I.** 2, 4 **II.** 1-1, 2-3, 3-7, 4-2 **III.** 1-a, 2-d, 3-a, 4-c **IV.** 1. conglomerate 2. calcium carbonate 3. chalk or calcium carbonate 4. granite 5. iron oxide 6. sandstone **V.** 1. true 2. true 3. calcium carbonate 4. shale **VI.** 1. The pebbles settle first. They are the heaviest of the mixture. 2–5. Relate your observations to your classmates.

### Chapter 5

**I.** 1, 2 **II.** 1-3, 2-6, 3-8, 4-5 **III.** 1-c, 2-a, 3-a, 4-d **IV.** 1. a. calcium carbonate b. iron (ferric) oxide c. carbon dioxide d. water 2. a. the temperature b. the mass c. the volume

### Chapter 6

**I.** 2, 3 **II.** An inorganic material is one which does not contain living material. 2. They are found both as elements and compounds. 3. the shine of a mineral 4. the colored powder formed when a mineral is rubbed on a porcelain plate **III.** 1-c, 2-d, 3-a, 4-b **IV.** 1.–3. Relate observations to your classmates. **V.** (Note to teacher: Ask the pupil to give the name of the following symbols.) 1. copper 2. sulfur 3. sodium chloride (salt) 4. calcium carbonated. **VI.** 1. a magnet 2. geiger counter 3. a magnifying lens 4. a geologic hammer

### Chapter 7

**I.** 1, 4 **II.** 1-5, 2-2, 3-2, 4-7 **III.** 1-b, 2-b, 3-b, 4-c **IV.** 1-d, 2-f, 3-b, 4-a, 5-e

### Chapter 8

**I.** 1, 4 **II.** 1-7, 2-6, 3-3 & 4, 4-4 **III.** 1-a, 2-d, 3-b, 4-a **IV.** 1-b, 2-a, 3-b, 4-b **VI.** A stalagmite is a concretion of calcium carbonate growing up from the floor of a limestone cave. A stalactite is the same as a stalagmite but grows downward from the ceiling of a limestone cave. They were called "icicles."

### Chapter 9

**I.** 2, 4 **II.** 1. yes! hardness, specific gravity tests and luster tests 2. Scouring powders contain pumice or sand or aluminum oxide. 3. Corundum is an aluminum oxide with a hardness of 9. It is used in emery paper. 4. Semiprecious stones are more numerous and available than precious stones. **III.** 1-a, 2-b, 3-c, 4-a

### Chapter 10

**I.** 2, 4 **II.** 1. cement made from limestone and clay 2. limestone and clay baked in a kiln 3. plaster of paris 4. clinker is the result of baking limestone and clay in a kiln. This is then ground up into the powder called cement. **III.** 1-a, 2-d, 3-a, 4-c **IV.** cement, clay, clinker, concrete **V.** 1-b, 2-a, 3-physical, 4-b.

### Chapter 11

**I.** 2, 3 **II.** 1-3, 2-2, 3-5, 4-6 **III.** 1-c, 2-b, 3-a, 4-d, 5-c **IV.** calcium-carbon-oxygen; sodium-carbon-oxygen; silicon-oxygen. **VI.** 3. The glass glows yellow because it contains the element sodium.

### UNIT II: Chapter 12

**I.** 2, 4 **II.** 1. Magma is molten rock within the earth's surface. Lava is the name given to magma when it reaches the earth's surface. 2. Changes of pressure inside the earth can cause earthquakes. 3. When underground water comes into contact with magma, the water changes to steam and shoots out through fissures in the earth. 4. The magma may be trapped in horizontal layers called sills or dome shaped masses or in vertical layers called dikes. **III.** 1-d, 2-b, 3-b, 4-b **IV.** 1-magma, 2-sills, 3-dikes, 4-domed mountains, 5-geysers, 6-tsunamis

### Chapter 13

**I.** 1, 4 **II.** 1. Lava cools to form lava rocks such as pumice, basalt, and obsidian. 2. by the cinders, ashes, and dust erupted by Mount Vesuvius in A.D. 79 3. A quiet volcano has lava oozing out of it. An explosive volcano erupts ashes, cinders and lava into the air. **III.** 1-a, 2-c, 3-a, 4-d **IV.** 1. Alaska 2. Hawaii 3. Italy 4. Mexico

### Chapter 14

**I.** 1, 3 **II.** 1-7, 2-5, 3-7, 4-2 **III.** 1-a, 2-a, 3-a, 4-a **IV.** 1. molten 2. igneous 3. sedimentary 4. igneous 5. artificial **V.** 1. Jura 2. obsidian 3. Hood 4. nitrogen 5. streak 6. Old Faithful 7. nucleus: JOHNSON

### Chapter 15

**I.** 1, 3 **II.** 1-3, 2-7, 3-6, 4-4 **III.** 1-a, 2-a, 3-d, 4-d **IV.** 2. The jar is broken by the expanding ice. 3. Water gets into the cracks of rocks, freezes, expands and breaks up the rocks. **V.** 1. $CO_2$ 2. freezing 3. sediment 4. atmosphere 5. hydrosphere

### Chapter 16

**I.** 2, 3 **II.** 1. Weathering is the process of breaking up rocks by oxidation, chemical action, and temperature changes with the weathered material remaining in place. Erosion is the wearing away and moving of the earth's surface by rivers, winds and glaciers. 2. This new land is called a Delta. 3. These ripples may be formed by the winds or may represent patterns formed by the waves. 4. Lack of rain, destruction of grasses, and high winds help form the Dust Bowl. **III.** 1-c, 2-b, 3-b, 4-a **IV.** 1. desert 2. volcanoes 3. chemical weathering 4. geysers 5. sediment 6. dust bowl **VII.** 1. a. Freezing water expands and causes great pressure. b. Rocks are weathered by freezing water and are made small enough to be carried by rivers. 2. a. Running water carried the fine sediment out of the pot. b. Rivers (running water) are agents of erosion. 3. a. The sudden change in temperature caused sudden changes in the volume of the glass. b. Temperature changes are agents of weathering. They break up the rock so that they can be carried by erosion agents.

### Chapter 17

**I.** 1,4 **II.** 1-2, 2-8, 3-4, 4-6 **III.** 1-b, 2-b, 3-c, 4-d **IV.** 1. humus 2. organic 3. absorb 4. subsoil 5. centimetres

### Chapter 18

**I.** 2, 4 **II.** 1-2, 2-5, 3-7, 4-5 **III.** 1-a, 2-b, 3-b, 4-b **IV.** 1-b, 2-a, 3-c, 4-a

### Chapter 19

**I.** 1, 3 **II.** 1. when it meets an impervious layer of rock such as shale 2. loosely packed sandy or humus soil 3. detergents are chemicals that act like soaps but do not leave a scum. 4. compounds of calcium and magnesium **III.** 1-c, 2-a, 3-a, 4-c **IV.** 1. groundwater 2. hard water 3. erosion 4. water table 5. sewers 6. evaporates 7. rainfall

### Chapter 20

**I.** 1, 3 **II.** 1. conserving water and building levees 2. contour plowing and planting and planting grasses with strong roots 3. It stores water for future use and helps prevent floods. 4. Desalination will make salt water useful to farmers. **III.** 1-a, 2-d, 3-b, 4-d **IV.** 1-c, 2-a, 3-e, 4-b **V.** 1. compound (salt)–elements 2. carbonate ($Na_2 CO_3$) 3. sand 4. 100 5. carbon

### Chapter 21

**I.** 1, 3 **II.** 1-5, 2-5, 3-7, 4-4 **III.** 1-a, 2-d, 3-b, 4c **IV.** 1. slope 2. topography 3. abrasive 4. relief: STAR

### Chapter 22

**I.** 2,4 **II.** 1-2, 2-3, 3-4, 4-2 **III.** 1-a, 2-c, 3-c, 4-a **IV.** 1. 80 m 2. 1500 m 3. 7.5 km **VI.** 1. Mississippi River: Missouri, Tennessee, Arkansas, Mississippi, and Louisiana 2. Army Corps of Engineers 3. levees and diversionary channels 4. damage to roads, farmhouses, farmlands, bridges and death to people 5. Yes! It is a tributary of the Mississippi River and sends in tremendous amounts of water into the Mississippi. 6. More water is sent into the Mississippi River by its tributaries than the river channel can hold and so it overflows.

### UNIT III: Chapter 23

**I.** 2, 3 **II.** 1-6 & 7, 2-3, 3-5 & 6, 4-7 **III.** 1-b, 2-b, 3-b, 4-c

### Chapter 24

**I.** 2, 4 **II.** 1-3 & 4, 2-2, 3-4, 4-7 **III.** 1-a, 2-b, 3-a & c, 4-b **IV.** 1. chalk 2. shellfish 3. sea 4. sedimentary rock 5. casts 6. decay 7. wooly mammoth

### Chapter 25

**I.** 2, 3 **II.** 1-6, 2-5, 3-3, 4-1 **III.** 1-a, 2-c, 3-d, 4-b **IV.** 1. water 2. erosion 3. bacteria 4. oxygen 5. glaciers 6. lowering the 7. magma 8. glaciers 9. blast furnace 10. desalination **V.** 1. False. As long as there are living things and the geologic processes, fossils will be formed. 2. False. As long as rivers deposit their sediment into oceans or lakes, sedimentary rock will be formed. 3. False. There are many young rivers especially in the headwaters of river systems.

**Chapter 26**

**I.** 3, 4 **II.** 1-5, 2-7, 3-8, 4-5 **III.** 1-b, 2-a, 3-a, 4-a **IV.** 1. true 2. sedimentary 3. true 4. water **V.** 1. one 2. thirty 3. third

**Chapter 27**

**I.** 2, 3 **II.** 1. The earliest life was found in the water. 2. They walked on thick legs. 3. about 60 million years ago 4. amphibians, reptiles, mammals **III.** 1-c, 2-a, 3-c, 4-c **IV.** 1. microscopic 2. water 3. amphibians 4. air 5. pines 6. mammals **V.** 1. Cro-magnon 2. Amphibian 3. Sedimentary 4. Horse: CASH

**Chapter 28**

**I.** 1, 3 **II.** 1. There are solid, liquid, and gaseous fuels. 2. It is used to make coal gas. 3. It is used for lubricants and pencils. 4. Old fern trees were turned into coal. **III.** 1-a, 2-d, 3-c, 4-c **IV.** 1. methane (compound) 2. oxidation 3. isotope 4. 10 5. plants **VI.** You have made a lubricant from the graphite in the pencil.

**Chapter 29**

**I.** 2, 4 **II.** 1-6, 2-7, 3-6, 4-7 **III.** 1-a, 2-b, 3-a, 4-b **IV.** 1. carbon 2. true 3. true 4. condensation

# CHEMISTRY 1—THE MATERIALS OF NATURE

**UNIT I: Chapter 1**

**I.** 1, 4 **II.** 1-4, 2-3, 3-4, 4-5 **III.** 1-a, 2-b **IV.** 1. solid and liquid 2. with difficulty 3. true 4. energy **V.** 3. It consists of matter and energy. **VI.** 3. Sometimes rocks are worn down by glaciers and rivers to the size of pebbles. **VII.** 3.

**Chapter 2**

**I.** 1, 2 **II.** 1-8, 2-7, 3-4, 4-2 **III.** 1-b, 2-d, **IV.** 1-d, 2-b, 3-d, **V.** Both have the same volume of $8\ cm^3$. **VI.** 1. Disagree. All substances have weight. 2. Disagree. The weight of the melted ice (water) is equal to the weight of the ice. 3. Agree 4. Disagree. A spring balance is used to measure the weight of a substance. **VIII.** 1. No. The sugar would dissolve in the water. Iron would be all right. 2. Place a mark with a china marking pencil before and after immersing the solid.

**Chapter 3**

**I.** 1, 3 **II.** 1-3, 2-2, 3-3, 4-4 **III.** 1-b **IV.** 1-c, 2-c, 3-d **V.** 1-d, 2-b **VI.** 1. False. Some liquids are colorless. 2. False. It does not lose weight. 3. False. Liquids take the shape of the container. 4. False. They have definite volumes. **VIII.** 1-c, 2-d, 3-e, 4-b, 5-a

**Chapter 4**

**I.** 1, 3 **II.** 1-3, 2-2, 3-3, 4-4 **III.** 1-d 2-b, 3-b, 4-c **IV.** (Note: Answers given are incorrect. Correct answer is 23 500 g.) 2-b **V.** 1. volume 2. shape

**Chapter 5**

**I.** 1, 4 **II.** 1-4, 2-5, 3-7, 4-4 **III.** 1-c, 2-b, 3-c, 4-c **IV.** 1. True. An electron microscope not an ordinary microscope 2. True. Mothballs and Dry Ice sublimate 3. False. Both have the same temperature but the water vapor has more heat. 4. True; under enough pressure and cooling but, usually, different gases that make up the mixture called air have their individual freezing points. 5. False. They change their arrangement in the substance. **V.** 1. solid 2. slowest 3. weight and volume 4. slightly 5. liquid into a gas 6. solid into liquid **VI.** The $CO_2$ gas which escapes from the bubbles is heavier than the air and cold enough to condense water vapor in the immediate vicinity.

**UNIT II: Chapter 6**

**I.** 2, 3 **II.** 1-5 (note 2 elements), 2-4, 3-4, 4-5 **III.** 1-d, 2-c, 3-c **IV.** 1-b, 2-b **V.** 1. mixture of gases 2. oxygen 3. electrical energy 4. twice **VII.** 1. The heat of friction causes the air in the tire to exert a great pressure.
0°C. Allow them to hang out until it gets warmer.

**Chapter 7**

**I.** 1, 3 **II.** 1-2, 2-3, 3-6, 4-5 **III.** 1-b, 2-c, 3-b, 4-b, 5-c, 6-d **IV.** 1. Disagree. All metals can change to the gaseous state if heated to a high enough temperature. 2. Agree; for most cases. 3. Agree. Most metals are found combined with oxygen sulfur or carbonates, etc. 4. Disagree. Iron is a stronger metal than copper. 5. Agree. It is also a good conductor of electricity. 6. Disagree. Nickle and cobalt are also magnetic. **VI.** 1. copper 2. hard 3. electron 4. mercury 5. iodine 6. silver 7. tube–CHEMIST

**Chapter 8**

**I.** 1, 3 **II.** 1. red and white 2. sodium and chlorine (NaCl) 3. helium (He) 4. nitrogen ($N_2$) **III.** 1. c (only very poorly), 2-c, 3-c **IV.** (see below)

| | color | odor | conducts electricity | solid, liquid or gas |
|---|---|---|---|---|
| SILVER | grey | none | yes | solid |
| bromine | RED | CHOKING | NO | liquid |
| NEON | colorless | NONE | NO | gas |
| COPPER | RED | NONE | yes | solid |
| NITROGEN | colorless | none | no | GAS |
| OXYGEN | colorless | none | NO | gas |
| TIN | grey | none | YES | solid |
| MERCURY | GREY | none | YES | liquid |
| IODINE | grey-black | none | NO | solid |

**V.** 1. alike 2. bromine and mercury 3. good 4. nitrogen and oxygen 5. stainless steel **VI.** 1-e, 2-c, 3-d, 4-a, 5-b **VII.** It takes on a plastic-like brown appearance. If this is taken out of water and allowed to dry out, it gradually changes back to a yellow crystalline form.

### Chapter 9

**I.** 3, 4 **II.** 1-2, 2-5, 3-2, 4-4 **III.** 1-c, 2-b, 3-c **IV.**

| Element | Symbol |
|---|---|
| GOLD | Au |
| silver | Ag |
| copper | Cu |
| ZINC | Zn |
| SODIUM | Na |
| POTASSIUM | K |
| MANGANESE | Mn |

**V.** 1-d, 2-e, 3-b, 4-a, 5-c **VI.** gold, copper, zinc, mercury, metal

### Chapter 10

**I.** 2, 3 **II.** 1-3, 2-5, 3-9, 4-6 **III.** 1-a, 2-c **IV.** 1-b, 2-c **V.** 1. true 2. true 3. mixture 4. true 5. true **VI.** Carbon; soot is a form of carbon.

### Chapter 11

**I.** 1, 2 **II.** 1-4, 2-5, 3-2, 4-5 **III.** 1-c, 2-c **IV.** b **V.** 1. Agree. The formula gives the composition of the compound. 2. Disagree. Some formulas are only for elements. The formula must be of an actual substance. 3. Agree. Ice is water in the solid phase. 4. Agree. It is $Cl_2$ and consists of 2 atoms. 5. Agree. It is an alloy (a mixture of metals) and only compounds have definite proportions.

### Chapter 12

**I.** 1, 3 **II.** 1-5, 2-4, 3-6, 4-7 **III.** 1-d, 2-b, 3-d, 4-a, 5-b, 6-a **IV.** 1. atomic numbers 2. group 3. metals 4. + one 5. metal to nonmetal

### UNIT III: Chapter 13

**I.** 2, 4 **II.** 1-3, 2-4, 3-4, 4-2 **III.** 1-c **IV.** 1-b & d. 2-c **V.** 1. word statement 2. formula 3. beginning 4. end 5. the same 6. coefficient

### Chapter 14

**I.** 3, 4 **II.** 1-1, 2-4, 3-6 **III.** 1-b, 2-a, 3-c **IV.** 1-b, 2-a **V.** 1. oxides 2. true 3. faster 4. cannot 5. cannot **VI.** A fish must obtain its oxygen by removing it from the water it takes into its gills. It cannot take the oxygen directly from the atmosphere.

### Chapter 15

**I.** 2, 4 **II.** 1. Spontaneous combustion is a slow oxidation with the accumulation of heat until the kindling temperature of the substance is formed and it bursts into flame. 2. To prevent oxidation resulting in rust that weakens the steel 3. There is not enough air for complete combustion of the gas. As a result a yellow flame is not as hot as a blue flame. 4. It is made of iron coated with tin. **III.** 1-b, 2-c, 3-c, 4-d **IV.** 1. true 2. all 3. dangerous 4. true 5. true **V.** a. fire b. oxygen c. oxide d. bunsen burner **VI.** painting, galvanizing (Zn), tin plating (Sn), copper plating (Cu), nickel plating (Ni), using stainless steel, covering with oil or grease

### Chapter 16

**I.** 2, 3 **II.** 1-5, 2-3, 3-2, 4-7 **III.** 1-c, 2-d, 3-a, 4-c **IV.** 1. Agree. $CO_2$ prevents the $O_2$ in the air from reaching the fire. 2. Agree. When it ($CO_2$) sublimates (changes to a gas) the $CO_2$ gas formed will change clear limewater to a milky-white color. 3. Disagree. Only green plants use $CO_2$ for food. 4. Disagree. It is $CO_2$. 5. Disagree. $CO_2$ can only be a liquid under certain conditions of pressure and temperature.

### Chapter 17

**I.** 1, 4 **II.** 1-2, 2-4, 3-4, 4-2 **III.** 1-c, 2-b, 3-a, 4-c, 5-a, 6-b **V.** (see below)

| | **Physical Change** | **Chemical Change** |
|---|---|---|
| Milk sours. | no | yes |
| Cloth fades. | no | yes |
| Bread is baked. | no | yes |
| A tea bag is put into $H_2O$. | yes | no |
| A new substance is formed. | no | yes |
| An object is ground up. | yes | no |
| A tree is sawed. | yes | no |
| An egg is cooked. | no | yes |
| Paints are mixed. | yes | no |
| Paints dry. | no | yes |

**VI.** 1. c 2. e 3. a 4. b 5. d

### Chapter 18

**I.** 1, 2 **II.** 1-2, 2-4, 3-6, 4-8 **III.** 1-c, 2-b **IV.** 1-b, 2-c, 3-d, 4-b

| **V.** | **Compound** | **Mixture** |
|---|---|---|
| Ice cream | No | Yes |
| Soup | No | Yes |
| Soap | No | Yes |
| Sugar | Yes | No |
| Salt | Yes | No |
| A sandwich | No | Yes |

### Chapter 19

**I.** 1, 2 **II.** 1-6, 2-8, 3-1, 4-3 **III.** 1-c, 2-d, 3-d, 4-b **IV.** 1. Agree. $2NH + Cl + Ca(OH)_2 \rightarrow 2H_2O + 2NH_3\uparrow + CaCl_2$ 2. Disagree. Only colored cloth that becomes oxidized and colorless can be bleached. 3. Disagree. The chlorine reacts with water to form free oxygen. The oxygen bleaches the cloth. **VI.** 1. $CO_2$, FeS 2. A compound has a fixed ratio by weight of the elements in it. A mixture does not. 3. $2H_2 + O_2 \rightarrow 2H_2O$ 4. It is a mixture. There is no fixed ratio by weight of the elements or compounds in it. 5. It is a conductor of heat and electricity, has a luster, hardness, is usually ductile and malleable, and can combine with a non-metal and usually gray in color. 6. It has many colors, is a poor conductor of heat and electricity, is not hard, and combines with metals. 7. a. silver sulfide b. calcium fluoride 8. Breathe out on a cold surface; water will form, condensed from the water vapor in your breath. Exhale into colorless limewater; if it turns milky white, $CO_2$ is present in your breath.

### Chapter 20

**I.** 1, 2 **II.** 1. Usually it is higher at a higher temperature because of the greater molecular activity. 2. An endothermic reaction is a reaction that absorbs heat. 3. A control is a frame of reference with which experiments can be compared. 4. $2HgO \rightarrow 2Hg + O_2$ **III.** 1-c, 2-c **IV.** 1-a, 2-b, 3-b **V.** 1. The heat is produced very slowly and is lost to the air. 2. No. No new substance is being formed. No burning takes place. 3. an endothermic reaction as heat is absorbed

### Chapter 21

**I.** 1, 4 **II.** 1-7, 2-6, 3-4, 4-1 **III.** 1-d, 2-a, 3-b **IV.** 1. distillation and filtration 2. true 3. iron 4. true 5. distillation **V.** 1. Heat the water. Air is insoluble in hot water. 2. Boil off the water. The sugar will remain. 3. Combine the mixture with water. The salt will dissolve in the water. Then filter out the salt solution leaving the chalk dust. **VI.** 1. Allow the open soda pop bottle to stand for some time in a warm place. The $CO_2$ gas will go off into the air. 2. Send in fresh water continuously. **VII.** 1. The heat makes the water boil off. 2. To condense the water vapor back into liquid $H_2O$ 3. To have a continuous supply of *cold* water or the water in the condensing tube will become warm 4. evaporation and condensation

### Chapter 22

**I.** 1, 3 **II.** 1-4, 2-5, 3-6, 4-6 **III.** 1-c, 2-b, 3-d **IV.** 1-b, 2-a **V.** 1. Disagree. Gaseous chlorine is identified by its green color and odor. Chlorides are identified by formation of white compound on adding $AgNO_3$ to unknown solution. 2. Disagree. It must be heated before the odor is detectable. **VI.** Dissolve powder in water. Add $AgNO_3$ to one part. Formation of white precipitate shows presence of chloride. To second part, add $Na_2SO_4$ solution. Formation of white precipitate shows presence of barium compound. **VII.** 1. The alcohol will separate out first. 2. Yes, it will be pure. 3. It prevents the water from boiling off and making the condensed alcohol impure.

### UNIT IV: Chapter 23

**I.** 1, 4 **II.** 1-2, 2-3, 3-4, 4-4 **III.** 1-a, 2-b **IV.** 1-c, 2-b **V.** 1. smallest 2. weight and volume, color, hardness, etc. 3. chemical 4. sum, atoms 5. can be seen with an electronic microscope **VII.** 2. Chemical reactions take place between molecules.

### Chapter 24

**I.** 1, 4 **II.** 1. Scientists say no. Actually all atoms are about the same size. 2. A molecule of water is 18 × the weight of the hydrogen atom. 3. X-rays have enabled scientists to see the insides of molecules. 4. Yes. This is ture for all molecules. **III.** 1-a, 2-a, 3-a **IV.** 1. different 2. true 3. never 4. true 5. true

### Chapter 25

**I.** 2, 3 **II.** 1-4, 2-6, 3-5, 4-1 **III.** 1-d, 2-c, 3-c **IV.** 1. Agree. They contain negative (electrons) and positive (protons) electricity. 2. Disagree. Protons and electrons are smaller. 3. Agree 4. Disagree. A few other elements are radioactive. **V.** Radioactive elements may be obtained from the Atomic Energy Commission at Brookhaven, New York.

### Chapter 26

**I.** 1, 2 **II.** 1-5, 2-4, 3-4, 4-5 **III.** 1-a, 2-b **IV.** 1-d, 2-b **V.** 4 **VI.** 1. true 2. electron 3. is not 4. true **VII.** 1. Society frowned upon women working in any field. 2. Yes! Now with women's lib and more women going to college we are beginning to find more women taking up science careers. 3. There is no such evidence.

**Chapter 27**

**I.** 1, 3 **II.** 1-3, 2-3, 3-5, 4-4 **III.** 1-c, 2-b, 3-b, 4-a **IV.** 1. electron 2. proton 3. neutron **V.** 1. Agree. If it loses electrons it is positively charged. 2. Disagree. Only the protons and the neutrons have the same weight. 3. Agree 4. Agree

**Chapter 28**

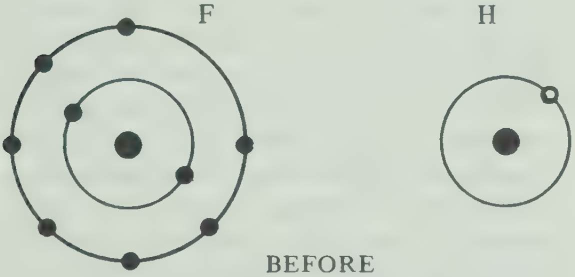
**I.** 2, 3 **II.** 1-1, 2-5, 3-1, 4-3 **III.** 1-b, 2-a **IV.** 1-6, 2-6 and 8, 3-2 **V.** 1. The sum of the protons and neutrons in each element is the same. 2. Hydrogen has an atomic mass of one, equal to mass of one proton. 3. Chlorine is a mixture of chlorine 35 and 37. Both have the same number. **VII.** 1. hydrogen 2. air 3. nitrogen 4. kilogram (Note Text should read 1000 g) 5. alloy 6. atom 7. radioactive 8. oxygen 9. nucleus: H A N K A A R O N

**Chapter 29**

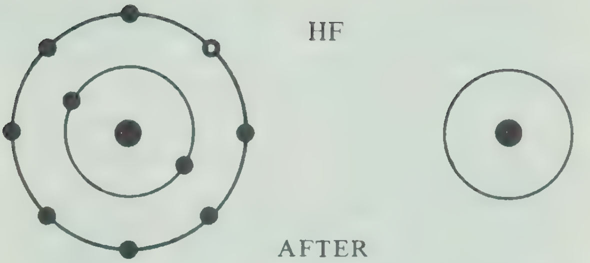
**I.** 1, 4 **II.** 1. orbit or energy shell 2. 3 electron shells 3. 32 electrons 4. Each new period stands for a new electron shell. **III.** 1-c, 2-a, 3-d, 4-c **IV.** 1. six 2. fifteen 3. thirty-six (Kr)

**Chapter 30**

**I.** 1, 3 **II.** 1-3, 2-4, 3-2, 4-5 **III.** 1-c, 2-a, 3-b, 4-c, 5-a **IV.** 1. carbon 2. argon 3. potassium **V.** 1.

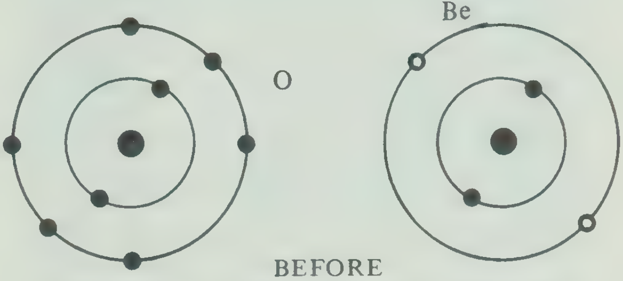


9 electrons BEFORE COMBINING 1 electron

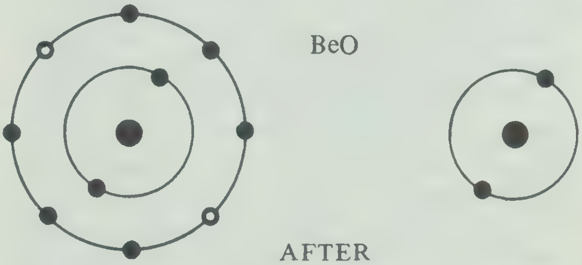


10 electrons AFTER COMBINING no electrons

2.



8 electrons BEFORE COMBINING 4 electrons



10 electrons AFTER COMBINING 2 electrons

**Chapter 31**

**I.** 1, 4 **II.** 1-3, 2-5, 3-6, 4-8 **III.** 1-d, 2-c **IV.** 1. False. Just a few 2. True. By the change of matter 3. False. He can with the aid of a cyclotron 4. True **V.** 1-d, 2-h, 3-g, 4-a, 5-c, 6-e, 7-b, 8-f, 9-i

# PHYSICS 1—THE FORCES OF NATURE

**UNIT 1: Chapter 1**

**I.** 2, 4 **II.** 1-5, 2-4, 3-2, 4-6 **III.** 1-a, 2-c, 3-c, 4-c, 5-b **IV.** 1. Disagree. It uses electric energy. 2. Agree. In the off position, the circuit is open or incomplete. 3. Disagree. The electric energy comes from the power house generators. 4. Agree. The electrical energy changes to heat energy because of the friction in the coils. 5. Agree. **V.** It is practical to set up a bulletin board display with all the switches. **VI.** 1. 1 lamp 2. 2 lamps 3. Connect the left wire to the right side of the switch and then close the switch.

**Chapter 2**

**I.** 2, 3 **II.** 1. The electrons move toward the positive end of the circuit. Opposite charges attract one another. 2. The voltage of a dry cell is 1.5 volts. 3. 2 electrons 4. A substance that allows an easy electron flow is said to be a conductor. A very poor conductor offers a very high resistance to the flow of electrons is called an insulator. **III.** 1-d, 2-d, 3-b, 4-c **IV.** 1. false-*electrons* 2. false-from the *negative* to the *positive* 3. true 4. true 5. true **V.** This holds a water solution of ammonium chloride (sal ammoniac) which chemically reacts with the zinc can. **VI.** 1. circuit 2. conductor 3. electron 4. voltage

**Chapter 3**

**I.** 1, 3 **II.** 1-3, 2-2, 3-5, 4-5 **III.** 1-a, 2-c, 3-b, 4-b **IV.** 1. false-volts 2. true 3. true 4. true **V.** 1-c, 2-d, 3-a, 4-e, 5-b **VI.** *Investigation #2*. 1. The needle will turn to E or W depending on the connection first made on the dry cell. 2. When the connections to the dry cell are reversed, then if the needle originally turned to E, it would turn to W. If it were at W it would turn to E. 3. The greatest number of degrees it (the needle) can turn is 90°. 4. The greater the number of degrees between 0–90 the needle turns, the more life in the cell.

**Chapter 4**

**I.** 2, 3 **II.** 1-4, 2-2, 3-5, 4-5 **III.** 1-c, 2-c **IV.** 1-c (Note: Add to sentence, *when connected in series*) 2-d **V.** 1. agree. When the switch is opened, the circuit is broken. 2. Disagree. When the positive (+) is connected to the negative (–) 3. Agree 4. Agree

**Chapter 5**

**I.** 2, 4 **II.** 1-6, 2-7, 3-4, 4-5 **III.** 1-c, 2-b **IV.** 1-d, 2-c **V.** 1. electrons 2. negative–positive 3. series 4. one 5. parallel 6. same amount **VI.** 1. All the appliances start working at the same time. 2. You can control the appliance you want to work at the time you need it.

**Chapter 6**

**I.** 1, 3 **II.** 1. If both are the same material and thickness, the longer the wire, the greater the resistance. 2. Large bulbs usually dissipate a higher power and therefore must have a lower resistance. 3. Resistance is measured in ohms. 4. If both wires are the same material and length, then the thinner the wire, the greater the resistance. **III.** 1-d, 2-d **IV.** 1-c, 2-b, 3-c, **V.** 1. volt 2. resistance 3. two times 4. negative-positive 5. two times the (if the two bulbs are similar) 6. decreases **VI.** 1. Tail lights have the most resistance. 2. Headlights have the thickest filaments.

**Chapter 7**

**I.** 1, 3 **II.** 1-5, 2-6, 3-2, 4-3 **III.** 1-c, 2-d, 3-b, 4-b, 5-c **IV.** 1. The resistance of the filament is less when it is cold than when it is hot. Therefore, more current goes through it and makes it brighter. 2. A fuse is connected in series with the lights which are connected in parallel. Therefore, when the fuse "blows" the circuit is open and all the branches are disconnected. 3. The current in the small bulb is less than the current in the large bulb. Therefore, it (the filament) needs a larger resistance. 4. The fuse metal has a lower melting point than the copper wire in the circuit. Therefore, it will melt (blow) and open the circuit before damage can be done to the copper wire in the wall. 5. This will cause the fuse wire to heat up and melt before the copper wire will.

**Chapter 8**

**I.** 2, 3 **II.** 1-3, 2-2, 3-1, 4-4 **III.** 1-b, 2-c **IV.** 1-b, 2-c, 3-b, 4-c **V.** 1-b, 2-c **VI.** 1. true 2. false-more 3. false-two **VII.** 1-c, 2-d, 3-a, 4-e, 5-b

**Chapter 9**

**I.** 1, 3 **II.** 1-4, 2-3, 3-6, 4-7 **III.** 1-c, 2-c, 3-c **IV.** 1-d, 2-b, 3-c **V.** 1. false-decreases 2. false-less bright 3. true 4. true 5. true

**Chapter 10**

**I.** 3, 4 **II.** 1. Electric energy can be produced by friction, chemical action, nuclear action, photo electric action, piezo–electric effect (squeezing of quartz crystals) and mechanical action. 2. by the use of a Cottrell Precipitator which removes very small particles from the air by an electric charge 3. light, mechanical energy, T.V., radio, heat, etc. 4. Sound travels by longitudinal pressure waves in the air, water or solids. **III.** 1-d, 2-b, 3-b **IV.** 1. electrons 2. amperes 3. resistance 4. resistance 5. increasing, series 6. less 7. resistance 8. decreased 9. electrically charged wires 10. waves **V.** 1-d, 2-e, 3-a, 4-b, 5-c

### UNIT II: Chapter 11

**I.** 1, 2 **II.** 1-5, 2-7, 3-2, 4-1 **III.** 1-d, 2-b, 3-a **IV.** 1. false-magnetic 2. true 3. false-at its poles 4. true 5. true **V.** The comb has a static electric charge. A charged body will attract any neutrally charged body even if magnetic. **VI.** 1. No. The steel in the building will detract the magnet from its N–S seeking position. 2. I would row 75° to the E of this reading.

### Chapter 12

**I.** 2, 3 **II.** 1-1, 2-3, 3-2 **III.** 1-b, 2-a **IV.** 1-b, 2-c

### Chapter 13

**I.** 2, 3 **II.** 1-3, 2-4, 3-1, 4-3 **III.** 1-b, 2-c, 3-a, 4-a, 5-b **IV.** 1. false-can 2. true 3. false-demagnetize 4. true 5. true **V.** 1-c, 2-e, 3-a, 4-d, 5-b **VI.** The unmagnetized rod can be attracted at both ends by another magnet. If the bars were free to turn, only one magnet would point in a N–S direction when freely suspended.

### Chapter 14

**I.** 1, 2 **II.** 1-2, 2-5, 3-3, 4-5 **III.** 1-c, 2-a, 3-a, 4-b **IV.** 1. iron 2. atoms 3. poles (ends) 4. 2 5. cannot 6. domains 7. temporary **V.** 1. false-magnetized 2. false-Temporary 3. false-may 4. false-permanent 5. false

### Chapter 15

**I.** 1, 4 **II.** 1. By sprinkling them over a magnet, or bringing a magnet close to the glass container which holds the filings. This is the method of magnetic induction. 2. Place two bar magnetic poles, close to but not touching one another. Place a piece of thin paper over the magnets. Sprinkle iron filings over the paper. Tap the paper and a magnetic map will appear. 3. It is strongest at these points. These are usually near a magnetic pole. 4. Yes. The experiment in #2 shows this to be true. **III.** 1-c, 2-c, 3-b, 4-b, 5-b and c **IV.** 1. true 2. true 3. false-curved 4. false-induction

### Chapter 16

**I.** 2, 4 **II.** 1-1, 2-2, 3-5, 4-6 **III.** 1-c, 2-a, 3-d, 4-c **IV.** 1. east of north 2. Michigan, Indiana, Ohio, Kentucky, Tenn., Ga., Florida, Ontario and Manitoba all are in the area of 0° declination. 3. Maine and Quebec. 4. Any state or province west of 0°. 5. Note the direction in which the needle of the compass points. Then use the magnetic declination map to find out how many degrees E or W his position is from true geographic north. **V.** 1. iron, cobalt and nickle 2. two 3. strongest 4. decreases, increases or increases, decreases 5. increases, increases 6. magnetized 7. magnetic field 8. repel, attract 9. clockwise or counter clockwise 10. oxide

### UNIT III: Chapter 17

**I.** 1, 2 **II.** 1. temporary magnets 2. soft–iron core 3. A wire carrying current is surrounded by a magnetic field. 4. It increases the strength of the electromagnet. **III.** 1-c, 2-d, 3-b, 4-a **IV.** 1. true (It is an electrical attraction.) 2. false-is (as long as current is flowing) 3. true 4. true **V.** 1. Disagree. They can be made of any metallic element. 2. Disagree. Only magnetic substances 3. Disagree. However, be careful the turns of the coil do not touch one another. 4. Agree. 5. Agree.

### Chapter 18

**I.** 1, 3 **II.** 1-7, 2-6, 3-8, 4-5 **III.** 1-b, 2-a, 3-b **IV.** 1. switch, electromagnet 2. soft–iron, open (broken) 3. two (usually), turn (rotate), reverses (changes), two 4. changing, more in or out, bringing the carbon particles closer or further apart

### Chapter 19

**I.** 2, 3 **II.** 1-1, 2-2, 3-2, 4-3 **III.** 1-c, 2-a, 3-b **IV.** 1. Agree. Induced current changes with direction of magnet. 2. Agree (same as 1). 3. Disagree. Current changes direction with changes in direction of the magnet (electromagnet). **V.** 1. a permanent magnet 2. a galvanometer 3. The direction of the galvanometer needle is reversed. 4. It works better if the wire is insulated as it will prevent shorts when bare wires touch one another.

### Chapter 20

**I.** 2, 3 **II.** 1-7, 2-3, 3-6, 4-2 **III.** 1-c, 2-d, 3-a **IV.** 1. coil of wire 2. increases, strength 3. magnetic field strength 4. dynamo **V.** 1. Water energy is cheaper than coal. 2. It cannot develop a voltage high enough for all the appliances in your home. 3. They send soot and CO and $CO_2$ and sulfurous noxious gases into the air.

### Chapter 21

**I.** 1, 3 **II.** 1-4, 5; 2-4, 3-3, 4-3 **III.** 1-a, 2-a, 3-b, 4-a **IV.** 1. A steady current does not allow the magnetic field in the secondary coil to change. 2. Note: be careful of shocks from the high voltage side. **V.** 1. U.L. means Underwriters Laboratories. 2. This sign means that the electrical appliance has been tested by special electrical tests and has been approved for consumer use. 3. It is dangerous to buy an electrical appliance not approved by U.L. because it may have some faults that have not been checked out.

### Chapter 22

**I.** 1, 3 **II.** 1-4, 2-4, 3-2, 4-3 **III.** 1-b, 2-c, 3-c **IV.** 1. Agree (until its chemicals are used up). 2. Agree. 3. Agree. 4. Disagree. They are not connected to one another. 5. Disagree. Only when it is a step up transformer **V.** 1. It is a step down transformer. 2. By using a tapped transformer.

This enables the operator to control the voltage output of the device. A lower voltage means a lower speed. Each tap is connected to a different secondary winding. The less the number of turns in the coil winding, the smaller the voltage.

**UNIT IV Chapter 23**

**I.** 2, 3 **II.** 1. Friction is the resistance created by rubbing one body on another. 2. The energy of motion of the hammer went into the nail and was changed to heat energy. 3. No. Heat is energy and therefore has no mass. 4. Ice is water in the solid phase. Vapor is water in the gaseous phase. **III.** 1-a, 2-b, 3-a, b **IV.** 1. false-molecules 2. true 3. true 4. false. All molecular motion supposedly stops at 0° Kelvin or Absolute Zero. **V.** 1. heat 2. energy 3. molecule 4. boiling 5. friction

**Chapter 24**

**I.** 1, 4 **II.** 1-4, 2-3, 3-4, 4-7 **III.** 1-b, 2-b **IV.** 1. As it is colder outdoors than indoors, the molecules of air come closer together and the ball gets smaller and soft. 2. The glass would expand faster than the mercury and the reading of the thermometer would become lower as the temperature increased. 3. As the molecules move faster, the space between them increases and the volume of the substance increases. 4. The cement expands making the sidewalk too large for the space it is in and so it moves upwards and buckles. **V.** 1. Agree. The steel expands.
2. Agree. The brass contracts more than the iron.
3. Disagree. The steel contracts leaving larger spaces between the rails. 4. Agree. The circumference of the ring got longer thus making the holes larger.

**Chapter 25**

**I.** 2, 4 **II.** 1-5, 2-5, 3-3, 4-5 **III.** 1-d, 2-c **IV.** 1-a, 2-c **V.** 1. false-usually (it depends on the mass of the object) 2. false-at a stop (theoretically) 3. false-twice the 4. false-usually (it depends on the mass of the object) 5. false-from the nail to the water

**Chapter 26**

**I.** 2, 3 **II.** 1-3, 2-5, 3-6, 4-9 **III.** 1-b, 2-b, 3-a, 4-a **IV.** 1-100 °C 2. 37 °C 3. 20 °C **V:** Alcohol freezes at —130 °C, boils at 78 °C: DIFFERENCE: 208 °C **VI.** 1. As the temperature drops, the air in the bulb contracts reducing the internal air pressure, The normal air pressure outside the bulb is now greater than that inside the tube, and pushes the water further up the tube.

**Chapter 27**

**I.** 2, 3 **II.** 1-3, 2-3, 3-5, 4-5 **III.** 1-c, 2-b, e-a **IV.** 1-c, 2-a, 3-c, 4-c **V.** 1. Disagree. When there is a change in phase there is no change in temperature but heat is taken in or given off. 2. Agree. 3. Disagree. 4. 2 J is the amount of energy necessary to raise one gram of water 1 °C. **VI.** condensation, boiling

**Chapter 28**

**I.** 1, 3 **II.** 1. by the process of radiation 2. No. It is a poor conductor of heat. 3. by convection currents 4. Yes. It is one of the best conductors of heat. **III.** 1-b, 2-b, 3-b **IV.** 1. energy 2. speed or velocity 3. 0 °C 4. higher, lower **V.** 1 silver 2. ohms 3. conduction 4. convection 5. evaporation 6. radiation:
SOCCER

# BOOK 2 SERIES

# BIOLOGY 2—BUILT FOR LIVING

**UNIT I: Chapter 1**

**I.** 3, 4 **II.** 1. Growth is the increase of size and weight of a living thing. 2. Assimilation is the process by which digested food is changed to living matter. 3. A terrarium is a land environment in an enclosed glass container. In this land animals are studied. 4. No! By life we mean any organism that goes through the life functions: ingestion, digestion, respiration, etc. **III.** 1-b, 2-a, 3-d, 4-a **IV.** Answers will vary. **V.** 1-f, 2-a, 3-c, 4-b, 5-d, 6-e **VI.** Pupils will have a "show and tell" session. **VII.** 1. Ecology studies the relationship of all plants and animals to one another. Biology is the study of all living things. 2. Atmosphere is the envelope of air surrounding the earth. Biosphere is the living community and all the non-living things in it. 3. Terrestrial refers to the land. Aquatic refers to the waters. **VIII.** 1. The green skin of the caterpillar blends in with the green leaves on which it feeds so that it can escape its enemies. 2. It helps the tree to decrease its water intake and prevents the freezing of the branches. 3. Automobile pollution (CO and $SO_2$) can cause the death of living things.

**Chapter 2**

**I.** 1, 3 **II.** 1-3, 2-5, 3-6, 4-4 **III.** 1-a, 2-c, 3-c, 4-a **IV.** 1. plant 2. vacuole 3. a single cell 4. skin 5. windpipe 6. connective **V.** 1. neRve 2. brAin 3. blooD 4. tIssue 5. biOlogy—RADIO **VI.** Using an overhead projector, show the class overlaid transparencies of the muscles and bones in the human body.

**UNIT II: Chapter 3**

**I.** 1, 3 **II.** 1-3, 2-4, 3-5, 4-2 **III.** 1-a, 2-b, 3-d, 4-b **IV.** 1. true 2. true 3. true 4. true 5. false; sugar **V.** 1. So that the contents in each test tube would have the same temperature. 2. So that the temperature would be like that in the intestines. Digestion goes on better in warm rather than in cold places. The molecules move faster. 3. Solids cannot pass through membranes. 4. The cell membrane **VI.** 1. Red litmus will turn blue in a basic solution, and, as saliva is slightly basic, the litmus will turn blue. 2. Yes! Separate water and chocolate syrup by a membrane. After a while, if the water becomes colored by the chocolate syrup, we know that the syrup has passed through the membrane.

**Chapter 4**

**I.** 2, 4 **II.** 1-6, 2-2, 3-5, 4-3 **III.** 1-c, 2-a, 3-a, 4-b **IV.** 1. gullet 2. food tube 3. sections 4. shapes 5. single cells, the ability 6. enzymes, absorbed **V.** Have the pupils report on their findings. **VI.** 1. Termites are not true ants, they belong to the order Isoptera while ants belong to the family Formicidae. 2. Termites eat wood. They have jaws that act like scissors. 3. Termites do not digest this wood. In their stomachs are one celled animals that digest the wood and the termites use this for their life functions. 4. The word is symbiosis.

**Chapter 5**

**I.** 1, 3 **II.** 1. The person "throws up" or vomits. 2. gall bladder, pancreas, and liver 3. in the stomach 4. saliva **III.** 1-d, 2-b, 3-a, 4-a **IV.** 1. true 2. true 3. bile 4. tripe 5. peristaltic action **V.** 1. gland 2. nutrient 3. fungi 4. protoplasm 5. system **VI.** 1-8, 2-3, 3-3, 4-5, 5-2 (Note: this totals 21, not 38 as shown in text.) **VII.** Get parent OK first before allowing this in class. **VII.** Display this poster on the bulletin board. **IX.** 1. Ingestion; food must be taken into the body before it can be digested. 2. Breathing; first the air must be taken into the body before it can be used for respiration or burning food for energy. 3. Digestion; what cannot be digested is excreted. 4. Digestion; only digested food can be assimilated.

**Chapter 6**

**I.** 2, 3 **II.** 1-6, 2-4, 3-4, 4-5 **III.** 1-b, 2-a, 3-c, 4-c **IV.** 1-4, 2-yes, 3-molars, canines **V.** 1-enzymes, 2-wisdom, 3-32, 4-maltose, 5-windpipe **VI.** This should be performed by the teacher. **VII.** Allow the pupils who bring these to class to discuss them. **VIII.** 1. crown, neck, root 2. on the outside of the crown 3. cement 4. to supply nutrients to the tooth 5. the nerve 6. Yes! It grows.

**Chapter 7**

**I.** 1, 3 **II.** 1-2, 2-4, 3-5, 4-3 **III.** 1-c, 2-a, 3-d, 4-a **IV.** 1. temperature on digestion 2. protein 3. Yes. There would be too much of a temperature change. It would not be a controlled experiment anymore. 4. Yes. There is pepsin present in the stomach wall of a cow. **V.** Be certain to point out the necessity for having a temperature of 38 °C in order for the experiment to succeed. **VI.** This is to be done in the laboratory. **VII.** 1. respiration 2. organ 3. biosphere 4. ecology 5. reproduction 6. tissue 7. oxygen 8. cartilage 9. laboratory 10. epidermis 11. minerals 12. enzyme 13. naturalist 14. tripe 15. ear

### Chapter 8

**I.** 1, 4 **II.** 1. in the small intestine 2. amino acids 3. The villi are covered by thin semi-permeable membranes through which digested food is absorbed. 4. glucose **III.** 1-a, 2-c, 3-a, 4-c **IV.** 1. You can add soap to the oil and water. 2. In the permanent emulsion, the red dye will stain the liquid. In the temporary emulsion, the red dye will sink to the bottom and the oil will float on top of it. **V.** A. 1. salivary glands 2. gullet 3. liver 4. gall bladder 5. pancreas 6. appendix 7. windpipe 8. stomach 9. small intestine 10. large intestine B. 1. mucus-secreting cells 2. wall of stomach 3. gastric gland cells 4. from gullet 5. artery 6. vein 7. to small intestines 8. stomach cut open lengthwise **VI.** Post the chart on the bulletin board.

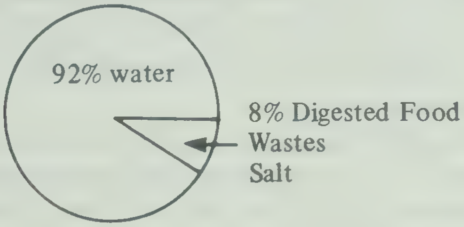
### Chapter 9

**I.** 1, 4 **II.** 1-4, 2-7, 3-6, 4-5 **III.** 1-d, 2-a, 3-b, 4-d **IV.** 1. cholesterol 2. pepsin 3. villi 4. ulcers 5. protein

### UNIT III: Chapter 10

**I.** 2,4 **II.** 1-6, 2-7, 3-8, 4-3 **III.** 1-b, 2-a, 3-b, 4-a **IV.** 1. (a) one litre, (b) water and wastes, they are included in plasma, (c) platelets, (d) red blood cells 2. (a) No. Plasma is a mixture. (b) water, digested foods and wastes

V. 1.



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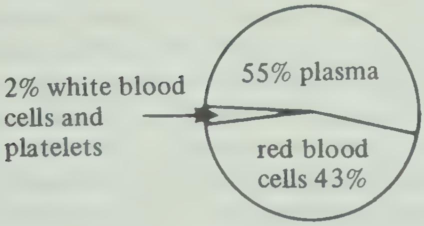


### Chapter 11

**I.** 1, 2 **II.** 1. The liver stores excess sugar. 2. body circulation to all cells; lung circulation to drop $CO_2$ and pick up $O_2$; liver circulation to deliver excess sugar for storage 3. The heart is a muscular pump made up of involuntary muscles. 4. The arterial capillaries osmose digested food into the cells. **III.** 1-c, 2-a, 3-c, 4-b **IV.** 1. False. Pulses vary with sex, age, weight, excitement, etc. 2. False. It may mean you have just been exercising, although it may also mean you are ill. 3. False. There are valves in the heart which would prevent this flow. 4. False. Unused sugar is stored as glycogen in the liver. **V.** 1. digested foods 2. oxygen 3. wastes 4. left ventricle 5. aorta 6. right auricle 7. right ventricle 8. carbon dioxide 9. left auricle **VI.** auriCle, plAteleT, Circulation, HEaRt–CATCHER **VII.** 1. 6 2. under age 65 and over age 65 (green area) 3. yes 4. 1 114 119 Heart; 352 719 cancer 5. all other causes 6. diseases of heart and blood vessels

### Chapter 12

**I.** 2, 4 **II.** 1-2, 2-4, 3-3, 4-5 **III.** 1-c, 2-c, 3-a, 4-d **IV.** 1. high 2. patients advised by the doctor 3. hardening of the arteries 4. veins 5. heart **V.** These reports should be read to the class and discussed.

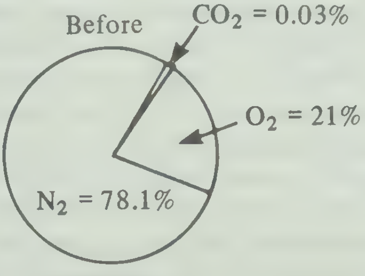
### Chapter 13

**I.** 1, 4 **II.** 1-4, 2-6, 3-6, 4-4 **III.** 1-a, 2-c, 3-a, 4-c **IV.** 1. vein 2. exhale 3. excretion 4. ventricle 5. white blood cells **V.** 1. No air could enter the balloons. 2. The lungs would explode. Lungs are very thin. 3. These are rings of cartilage which keep the windpipe firm. **VI.** 1. The oxygen (air) in the water has been boiled out. 2. near the liver 3. the stomach or tripe 4. Both the nose and the mouth are connected to the windpipe. **VII.** Have the children bring the animal parts to school. Dispose of these parts right after the demonstration.

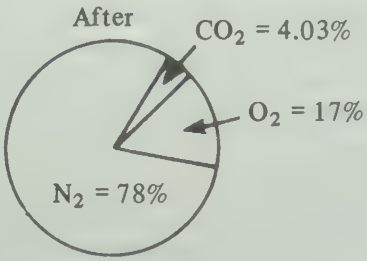
### Chapter 14

**I.** 1, 3 **II.** 1. Ventilate your home by having the windows opened wider on the top than the bottom. This will act as a natural air circulator. 2. Tars are thought to be a direct cause of cancer. 3. virus infection, tuberculosis, pneumonia, influenza 4. Check your rate of breathing before and after exercising. The rate increases after exercising. **III.** 1-b, 2-b, 3-c, 4-a

**IV.**



Breathing



Breathing

**V.** 1. It is lighter than fresh air and is moved out of the top of the window by convection currents. 2. convection currents 3. Discuss the various answers. **VI.** 1. nasal passage 2. oral cavity 3. epiglottis 4. esophagus 5. windpipe or trachea 6. diaphragm 7. voice box 8. left lung

### Chapter 15

**I.** 1, 3 **II.** 1-2, 2-2, 3-4, 4-6 **III.** 1-d, 2-a, 3-c, 4-b **IV.** False. Laxatives help a person to get rid of his solid wastes. 2. False. This process produces heat and energy and gives off $CO_2$ and $H_2O$ as wastes. 3. False. Insulin helps diabetics to use up their sugar. 4. False. These come from digestion and respiration. **V.** 1. 3 sections 2. on the right side 3. on the right side **VI.** The bottle of limewater containing exhaled air will turn milky white. $CO_2$ gas turns limewater milky white.

**VII.**

| | | | | | | | | |
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### Chapter 16

**I.** 2, 3 **II.** 1-2, 2-2, 3-5, 4-5 **III.** 1-b, 2-a, 3-d, 4-a **IV.** 1. large intestine 2. perspiration 3. feces 4. pimples 5. feeling **V.** 1. It has a very great cooling effect. 2. The temperature reading on the alcohol-cotton thermometer would be lower than the one wrapped in water-cotton. Alcohol is more volatile and cools the thermometer faster than the water does. **VI.** 1. True. Your pores should be kept clean. 2. True. If both kidneys are removed, the person will be poisoned by his own wastes. 3. True. If the skin has a glow to it, is clean, and has no sores or pimples, then that person is probably in good health. **VII.** 1. kidney 2. excretion 3. appendix 4. colon 5. bladder 6. kilogram 7. nerve 8. urine 9. anemia 10. sodium chloride

### UNIT IV: Chapter 17

**I.** 3, 4 **II.** 1. They help form sour cream, buttermilk and cheese. 2. When conditions are not good for reproduction, germs form spores. Later when the proper temperature and moisture are provided, the spores grow into germs and start reproducing. 3. Malaria, T.B., Scarlet Fever, Typhoid, etc. 4. They grow and reproduce in other living things. **III.** 1-d, 2-c, 3-c, 4-c **IV.** 1. True. Some germs are bacteria or viruses. 2. False. The bacteria have to enter our blood stream. Also, not all bacteria cause diseases. 3. True. It prevents bacteria of decay from reproducing. **V.** 1-f, 2-i, 3-a, 4-c, 5-d, 6-g, 7-h, 8-e **VI.** Bottle B at room temperature will have a cheese odor and an acid taste. Bacteria were able to reproduce and give off their wastes in the warm milk. Bottle A (refrigerated) was not warm enough to allow the bacteria to reproduce. **VII.** Allow the pupils to read their reports to the class.

### Chapter 18

**I.** 1, 2 **II.** 1-6, 2-5, 3-1, 4-4 **III.** 1-a, 2-c, 3-b, 4-c **IV.** 1. 20 minutes 2. to be certain that only the microbes growing in the agar are being studied 3. to create an ideal temperature for the growth of bacteria 4. 37°C 5. Answers will vary. **V.** 1. Antiseptics prevent infection. Germicides kill germs. 2. They discovered milder antiseptics. Carbolic acid is too corrosive. 3. These are mercury vapor lamps. They emit ultraviolet rays which kill germs. **VI.** Have these reports read and discussed in class. **VII.** The teacher should help demonstrate the workings of the pressure cooker.

### Chapter 19

**I.** 1, 4 **II.** 1. a. Get the bacteria from a sick person. b. Grow bacteria in a pure form. c. Inject bacteria in a healthy animal. d. See if animal gets same sickness as sick person. 2. These are chemicals formed in the blood which neutralize toxins. 3. An increase in the white blood count may mean illness. 4. Protection from a disease **III.** 1-b, 2-a, 3-d, 4-a **IV.** 1. antiseptic 2. germ 3. sterilization 4. illness **V.** 1. infectious 2. resistance 3. hairs 4. mucus 5. secretions 6. antitoxins 7. white blood cells 8. immunity **VI.** Discuss these reports with the class. **VII.** Have students report their observations to the class.

### Chapter 20

**I.** 1, 2 **II.** 1-3, 2-4, 3-5, 4-3 **III.** 1-c, 2-c, 3-d, 4-a **IV.** 1. True 2. True. It starts the healthy body to prepare antibodies. 3. False. Vaccines have been developed for many but not all disease (cancer, etc.). 4. True. They fight the toxins (poisons) produced by the germs. **V.** 1. serum 2. polio 3. agar 4. malaria **VI.** Post these pictures on the bulletin board. **VII.** Each one is better for a certain disease. The vaccines can help prevent a disease from being "caught" by a person. Antibiotics can kill germs and stop infection.

### Chapter 21

**I.** 1, 3 **II.** 1-5, 2-4, 3-6, 4-4 **III.** 1-b, 2-c, 3-a, 4-b **IV.** 1. This is important to find out if one of the marriage partners is suffering from VD. 2. This process prevents the spread of typhoid and TB. Both of these laws are for the good of the majority of citizens. **V.** 1. typhoid, TB 2. rabies 3. typhoid 4. TB, colds 5. TB 6. malaria, yellow fever 7. TB 8. malaria, yellow fever

### UNIT V: Chapter 22

**I.** 1, 2 **II.** 1-1, 2-4, 3-6, 4-5 **III.** 1-c, 2-b, 3-d (grasshopper) 4-b **IV.** Fig. 142-1 1. This controls the experiment. The flashlight is the only light. 2. This controls the direction in which the flies will move. Fig. 141-2. 1. To the negative. This is the electrode attached to the negative of the dry cell. 2. When the connections are reversed, the paramecia move again to the negative electrode. Fig. 140-1. 1. Yes. Otherwise the plants will die. 2. Yes. The plants grow toward the light. 3. The stems grow toward the pot. It contains water. **V.** 1. tropism 2. roots 3. urine 4. muscle 5. paramecium 6. experiment 7. tissue: TRUMPET **VI.** Suggest that someone in the class who owns a camera take pictures to show to the class.

### Chapter 23

**I.** 1, 4 **II.** 1. Nothing! We see only by reflected or incident light. 2. the circular canals of the ears which contain fluid and tiny hairs 3. We have four tastes: sweet, sour, bitter and salty. All other "tastes" actually smell. 4. It may not prick a pain nerve. **III.** 1-d, 2-a, 3-c, 4-a **IV.** 1. in order to locate the precise spots 2. so that he cannot see what he is tasting 3. in order to clear out any taste-forming chemicals 4. If the nose were stopped from getting any odors he could not tell the difference. **V.** 1. iris–colored part of the eye which regulates the amount of light entering the eye 2. pupil–the opening through which light enters the eye 3. auditory nerve–the pair of nerves leading from the inner ears to the brain 4. retina–the part of the eye on which the image forms 5. eardrum–the membrane between the outer and middle ear which transmits sound to the bones of the middle ear 6. optic nerve–the part of the eye that sends the image to the brain. **VI.** 1. True. He has never seen red and therefore has no nerve impression of that color. 2. True. If he had a good "ear" or memory he would remember the tune. 3. True. It stimulates the person to withdraw from the danger. Some lepers who have lost their feelings of pain can have their entire hands burned off without realizing it. **VII.** Display and discuss these posters with the class.

### Chapter 24

**I.** 1, 2 **II.** 1-5, 2-5, 3-7, 4-3 **III.** 1-c, 2-c, 3-b, 4-d **IV.** a-S, b-S, c-R-gravity, d-S, e-R-fright, chill, f-R-fear, g-R-sunlight, h-R-sees and smells milk, i-R-sees and smells a nut, j-S **V.** 1-12, 2-62, 3-3, 4-$\frac{1}{6}$ sec. **VI.** 1. True. It informs a person of a drop in temperature and also helps warm him for the moment. 2. False. It depends on where in the cerebrum the clot occurs. It may affect his sight, hearing, etc. 3. False. It brings stimuli to the brain. 4. False. Both can have the same time reaction since sneezing is a reflex action. **VII.** 1. Suggest that this brain be refrigerated and not kept out too long in room temperature as it may "spoil." 2. These are to be thrown out after use.

### Chapter 25

**I.** 1, 2 **II.** 1-2, 2-4, 3-6, 4-8 **III.** 1-b, 2-c, 3-a, 4-a **IV.** 1. True. Trial and error is a more time consuming method and may be dangerous in certain situations. 2. True. There are many memory-training methods. 3. False. They could be reconditioned. 4. False. It would take time before he retrains himself. 5. False. Homework helps students learn to think and remember. **V.** 1. cerebrum, learning 2. 12 pairs of head nerves, lead nerve impulses to the skull 3. medulla, breathing and heartbeat 4. 31 pairs of body nerves, lead nerve impulses to the spine 5. cerebellum, balance and coordination 6. spinal cord, nerves to the brain **VI.** 1. to have the dog bring the newspaper to you 2. Show the dog what to do and reward him with some tidbit when he does it. You may have to repeat the act many times. But you have to be patient and kind. 3. It would be interesting to keep notes on how long the training took. **VII.** Report to class. **VIII.** If successful, the pupil may report his method to the rest of the class.

### Chapter 26

**I.** 1, 4 **II.** 1. A person who has personal confidence seems to have more pep and is able to succeed in his undertakings. 2. Yes! If they do not give a person pleasure, hobbies are a waste of time. 3. No! Addiction means complete dependence on a drug. 4. No! Good physical health is needed for good mental health. **III.** 1-a, 2-c, 3-d, 4-c **IV.** 1 False. Many good athletes are honor students. Supreme Court Justice White was an All-American football player. 2. False. It depends on your choice of friends. 3. False. Wine contains alcohol also. 4. False. Any addict suffers intensely. **V.** 1. Read reports to class. 2. Make up a chart for your bulletin board. **VI.** These can be reported to the class if the pupil is willing to do so.

# EARTH SCIENCE 2—OCEANS OF AIR AND WATER

**UNIT I: Chapter 1**

**I.** 2, 3 **II.** 1-2, 2-6, 3-7, 4-3 **III.** 1-c, 2-a, 3-c, 4-b **IV.** 1. erosion 2. river 3. lead 4. spin 5. sedimentary rock 6. water **V.** 1. False. Water is found in the atmosphere in the forms of vapor and ice. 2. True. That is how hot springs and geysers get their heat. 3. True. Igneous rocks are formed from cooling magma. 4. True. The material eroded from mountains is sometimes deposited as soil where man can use it for planting. **VI.** 1. Mercury is the closest planet to the sun. 2. oxygen forms largest amount, sodium the least amount 3. sedimentary

**Chapter 2**

**I.** 1, 3 **II.** 1. Yes! Archimedes' Laws of Flotation apply to all fluids. The atmosphere is a gas which is a fluid. 2. Yes! But their passage is controlled by the atmosphere. 3. Yes! Air is matter and matter has mass and takes up space. 4. The stratosphere layer of the atmosphere reaches up to 32 km above the earth's surface. Here we find horizontal currents. **III.** 1-d, 2-b, 3-b, 4-a **IV.** 1. He could have shown a balloon. 2. I'd use about 21 cm. 3. This shows the percent composition of the air by volume. 4. It is easier for the class to see. Otherwise air would get in and spoil the experiment. It would be difficult. **V.** 1. atmosphere 2. mixture 3. gases 4. layers 5. troposphere 6. oxygen 7. $CO_2$ 8. space 9. mass 10. charged particles **VI.** 1. True. The higher the balloon rises, the less pressure outside it. Therefore, the pressure inside the balloon may be great enough to burst the balloon. 2. To allow air to enter the can and equalize the pressure. 3. It can go to higher altitudes without survival considerations. The disadvantages are (1) that we cannot control its movement too well and (2) that we may not be able to retrieve it.

**UNIT II: Chapter 3**

**I.** 1, 3 **II.** 1-7, 2-6, 3-3, 4-7, **III.** 1-a, 2-b, 3-c, 4-c **IV.** 1.a. The air would enter the can as fast as the air was drawn out by the pumpt. b. The air would re-enter the can. c. Air would be pumped into the can and its sides would bulge out. 2. If done carefully enough, the cardboard will remain in place. The pressure at any level is the same in all directions. **V.** 1. helium 2. oxygen 3. troposphere 4. radium 5. orbit 6. dioxide—HOT ROD **VI.** This should be done in the classroom under the supervision of the teacher.

**Chapter 4**

**I.** 1, 4 **II.** 1-7, 2-6, 3-7, 4-5 **III.** 1-d, 2-c, 3-b, 4-c 1. True 2. False, the barometer works. 3. False. You can take it to the top of the mountain. 4. False. he means that the barometric pressure is getting less. **V.** The report can be read to the class **VIII.** 1. at about 9.2 km. 2. As the density of the atmosphere varies with altitude and latitude one cannot use the simple formula given. 3. This is done in order to keep the passengers comfortable at normal sea level pressure. This is done by making the plane airtight and increasing the pressure in the cabins. 4. The passengers would begin to bleed from their noses and eyes. **IX.** 1. The tubeless tires can be repaired on their rims, in case of punctures. 2. These answers will vary with different barometers.

**Chapter 5**

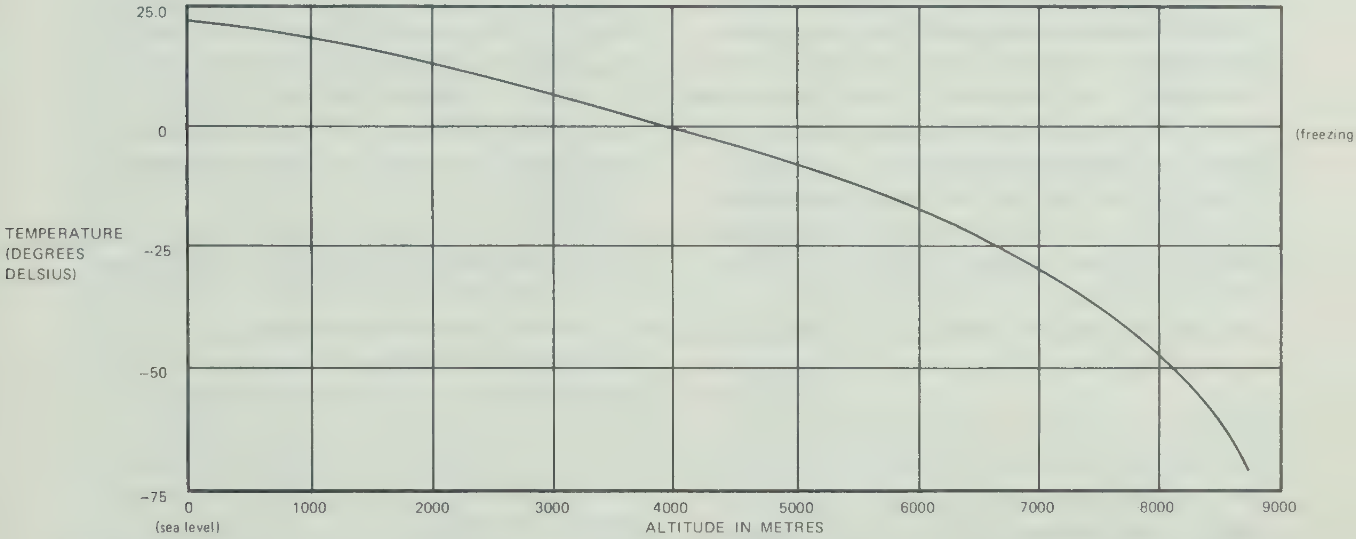
**I.** 2, 4 **II.** 1. Any pressure greater than 100 kPa is called compressed. 2. Compressed air, when released, drives sand particles with great enough speed to blast dirt or paint off old buildings. 3. The air pressure is so low that air cannot be pushed into the lungs quite as easily. 4. When the water falls out of the lower end of the siphon tube, the air pressure inside the tube is reduced. Normal air pressure on the surface of the water on the upper tank pushes the water through the tube. **III.** 1-a, 2-c, 3-a, 4-c **IV.** 1. on the surface of the liquid 2. to reduce the air pressure inside the vacuum cleaner 3. The vaseline will help the plunger stick to the surface better. 4. the bottle facing into the water The air in it has been compressed. 5. You could fill the siphon with water, leaving one end in the tank. Pinching the other end closed, lower it into a jar and release the end. The water will flow out of the fish tank. **V.** *Across* 1. deice 4. oxygen 7. tongs 9. siphon 10. density. *Down* 1. distill 2. compressed 3. ex 5. gem 6. Ni 7. ten 8. Neon **VI.** Demonstrate this to the class. **VII.** 1. no interference with traffic or people and can be in a straight line 2. A caisson is a device (structure) in which people can work on river bottoms. It is air tight. 3. Sandhogs are people who work in caissons. 4. The "Bends" is a condition brought about by the too rapid de-compression of a person. A typical example is a diver who is brought up to the surface too fast. 5. about 100 kPa.

**Chapter 6**

**I.** 1, 2 **II.** 1-7, 2-3, 3-5, 4-2 **III.** 1-a, 2-c, 3-b **IV.** 1. This is so that both get the same intensity of heat. 2. It would make very little difference. Even though white sand reflects radiant energy better than black, the sand is a better absorber of heat than water. 3. In both these cases the temperature readings would be the same. 4. Yes. It would control the experiment. **V.** 1-g, 2-a, 3-b, 4-f, 5-j, 6-c, 7-e, 8-i **VI.** Demonstrate to the class.

**Chapter 7**

**I.** 1, 2 **II.** 1-5, 2-6, 3-3, 4-2 **III.** 1-c, 2-a, 3-b, 4-a **IV.** 1. True. At some high altitudes the snow lasts all year. 2. False. The temperature reading is 16.1 °C. 3. False. The closer to the flame, the more rapidly the pinwheel will spin. 4. False. The mercury thermometer on the left will break when the temperature gets too high. **V.** See the diagram below. **VI.** Post this report on the bulletin board. **VII.** 1. Both are the same as they represent the boiling point of water in two different scales. 2. 20 °C — 4 x 2 °C = 12 °C.



**Chapter 8**

**I.** 1, 4 **II.** 1. During the day, the land is warmer than the sea. Therefore, its (land) air pressure is lower than the air pressure over the sea. Winds blow from high pressure to low pressure and take their names from the direction they come. 2. They are started by the differences in air pressure caused by differences in amount of solar radiation received by the different parts of the earth. 3. These are at the equator and the horse latitudes. 4. This is due to the rotation of the earth. **III.** 1-a, 2-b, 3-d **IV.** 1. True. But the main cause is the difference in heat the various parts of the earth receive. 2. True 3. sea breeze 4. convection 5. True **V.** 1, 2. These are to be demonstrated to the class. **VI.** 1. The air currents would be rising over both candles. The convection currents would start over both candles. 2. The currents would be reversed because the water has a higher specific heat than the land and would be of a higher temperature.

| **VII.** | Horse Latitudes | Doldrums |
|---|---|---|
| Air pressure | *high* | *low* |
| Temperature | *low* | *high* |
| Currents | *falling* | *rising* |
| Winds | *calm* | *calm* |

**Chapter 9**

**I.** 1, 4 **II.** 1-1, 2-3, 3-5, 4-7 **III.** 1-b, 2-b, 3-a, 4-c **IV.** 1. clouds 2. frost 3. dew 4. dust 5. precipitation 6. crystals 7. water 8. cumulonimbus **V.** 1. condensation 2. unsaturated 3. frost 4. sea breeze 5. southeasterly **VI.** 1. The water vapor in the exhaled breath condenses on the lenses. The glasses can then be cleaned. 2. The air is saturated with water. 3. This prevents water vapor in the air from condensing on the pipes and causing rust. **VII.** Demonstrate this to the class. **VIII.** 1. The steam will condense on the outside of the flask. 2. condensation 3. drops of water 4. Yes. The dew point is the temperature at which condensation takes place.

**Chapter 10**

**I.** 2, 4 **II.** 1. They trap the wastes and cause them to be concentrated. 2. Smoke is trapped in fog.

3. CO, a poisonous gas, is formed. 4. Pollutants are added to the air in greater quantities. **III.** 1-d, 2-b or c, 3-c, 4-d **IV.** 1-j, 2-e, 3-1, 4-1, 5-y, 6-a, 7-p, 8-p, 9-1, 10-e **V.** 1. No difference, as the candle burns with a yellow flame also. 2. There are blowers installed which blow out the polluted air and allow fresh air to enter. 3. This allows the CO gas and carbon to be completely burned before leaving the tailpipe. **VI.** Post material on bulletin board. **VII.** Report to the class.

**UNIT III: Chapter 11**

**I.** 1, 4 **II.** 1. The weather elements are a. air pressure b. air temperature c. relative humidity d. wind velocity e. wind direction f. state of sky g. precipitation 2. National Oceanic and Atmospheric Administration 3. It gives faster communication of data. 4. everyone **III.** 1-c, 2-a, 3-a, 4-b **IV.** 1. 100 2. 94% 3. 0 °C 4. west 5. fog 6. dew 7. lighter and wetter 8. how much moisture is in the air **V.** 1. They are based on repeated observations of certain phenomena. 2. He must understand the physical movements of air, air pressure, and the chemical makeup of air and the kind of pollutants in the air. **VI.** 1, 2. These will help make up a bulletin board on weather.

**Chapter 12**

**I.** 1, 3 **II.** 1-2, 2-3, 3-5, 4-6 **III.** 1-a, 2-d, 3-c, 4-a **IV.** 1. It shows wind velocity in miles per hour. 2. This is so the housing will reflect most radiant heat and allow meteorologist to read the temperature of the air in the shade. 3. They would show the same reading on both maxi and mini because there is no change in temperature. 4. It would mean that the wind was blowing from the east. Winds take their names from the direction from which they come. **V.** 1-g, 2-b, 3-d, 4-e, 5-h, 6-a

**Chapter 13**

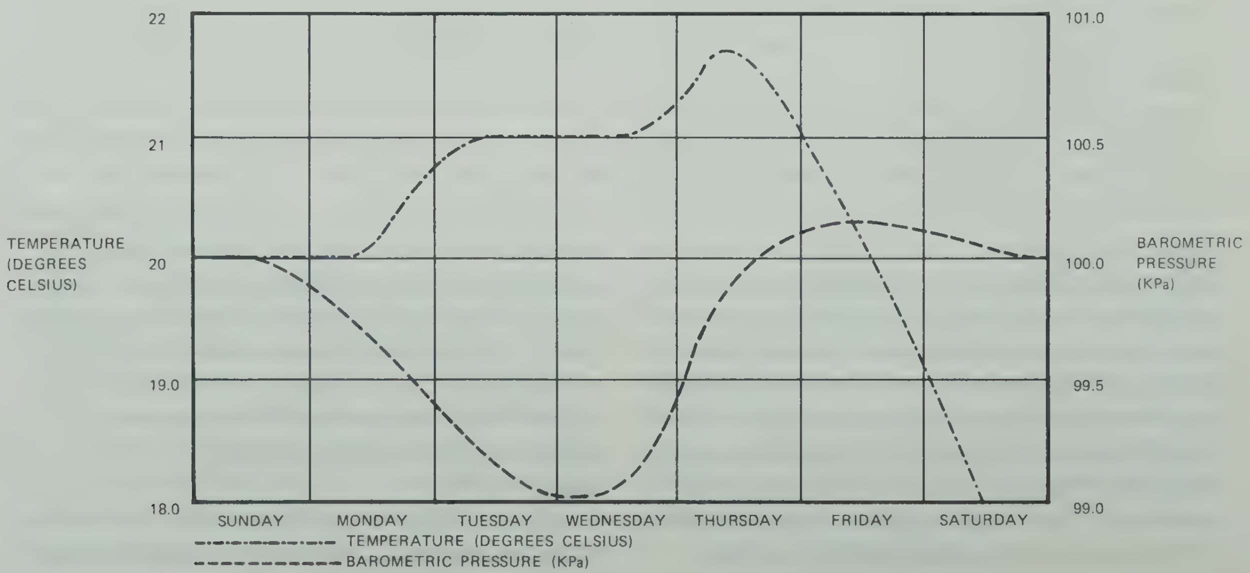
**I.** 1, 4 **II.** 1-7, 2-4, 3-5, 4-4 **III. 1-d, 2-c, 3-a, 4-d** **IV.** 1. troposphere 2. air masses 3. continental 4. maritime 5. Canada 6. Pacific Ocean 7. environment 8. larger **V.** 1. air mass 2. front 3. barometer 4. precipitation 5. cloud **VI.** 2. In a high, the movement of the air is from the center down and outward in a clockwise motion. In a low, the movement of the air is counterclockwise into the center and then upward. 5. The formation of highs and lows depends on pressure differences which in turn depend on temperature changes. Therefore, highs and lows are formed all over the surface of the earth in about the same amounts.

**Chapter 14**

**I.** 2, 3 **II.** 1. This is a legend which helps one interpret a weather map. 2. Aviation Weather Service, Agricultural Service, Fire Weather Warning Service 3. lines connecting places having the same pressure at the same time 4. 80%. Sudden changes in the atmosphere cause weather changes. **III.** 1-c, 2-a, 3-b, 4-c **IV.** 1. False. The pressure is highest in the center of a high. 2. True. This will show you the precise weather trend. 3. False. The conditions of weather in any one place are seldom the same for any one date from year to year. 4. True. As the air is moved upward in the center of a low, the water vapor cools and condenses to form clouds. 5. False. They are right about 292 days out of the year, or 80% of the time. **V.** Have students discuss these projects with the rest of the class. **VI.** Have students discuss these projects with the rest of the class.

**Chapter 15**

**I.** 2, 4 **II.** 1-5, 2-8, 3-6, 4-10 **III.** 1-c, 2-d, 3-c, 4-c **IV.** 1. As the warm air moves up in the center of



the low, the water vapor condenses forming huge cumulus clouds. In the summer this is a very fast process and thunderstorms result. 2. This is the time of the year when hurricanes originate in the Caribbean Sea. The U.S. Weather Bureau studies the paths of these hurricanes. 3. These hurricanes are blown out to sea, when they are near Cape Hatteras, by the S. W. Westerlies. They may get to Boston but almost never to the Great Lakes. **V.** 1. northwest and then east 2. near the West Indies 3 . toward the outside circles 4. isobars 5. counterclockwise 6. away from the equator 7. about 11 hours **VI.** Post this information on the bulletin board. **VII.** Report to class.

### Chapter 16

**I.** 1, 4 **II.** 1-4, 2-3, 3-7, 4-5 **III.** 1-d, 2-c, 3-b, 4-d **IV.** 1-a, 2-d, 3-c, 4-b, 5-e, 6-c, 7-a **V.** Have students report their findings to the rest of the class. **VI.** Post on the bulletin board. **VII.** 1. You have to know two, the highest and lowest temperature of the year. 2. Add up the number of inches of rain that fell in 12 days and divide your total by 12. 3. It would be about 12°C lower than the temperature at sea level. **VIII.** Report findings to class.

### UNIT IV: Chapter 17

**I.** 2, 4 **II.** 1. by collecting samples of water and sediment and analyzing them in a laboratory 2. The latest figure for 1965 was 45 days. 3. southern hemisphere 4. All oceans are connected. **III.** 1-c, 2-c, 3-c, 4-c **IV.** 1. True. 2. False. A bathysphere is lowered or raised by a cable. A bathyscaphe can sink and surface like a submarine. 3. False. A knowledge of geography is very important in all studies of oceanography. One should know where the oceans are located. **V.** 1. Atlantic 2. Atlantic 3. Yes. The area of the Pacific is 64 million square miles. The area of the other three oceans is 65 million square miles. 4. 129 million square miles **VI.** 1. Jacques Piccard is an underwater explorer who took the Tireste to the bottom of the Pacific Ocean 2. M. Scott Carpenter is a navy aquanaut who stayed underwater for 45 days. 3. Jules Verne was a famous author who wrote about the submarine, 50 years before it was invented. 4. Jacques Cousteau is a French aquanaut who spent 6 days underwater. **VII.** 1. self-contained underwater breathing apparatus 2. research vessel or research vehicle 3. underwater research vessel (vehicle)

### Chapter 18

**I.** 1, 3 **II.** 1-3, 2-4, 3-5, 4-3 **III.** 1-a, 2-c, 3-d, 4-c **IV.** 1. True. The waters receive more heat here. 2. False. Fungi need the $O_2$ that green plants give off. 3. True. The fish need the $O_2$ that green plants give off during the photosynthesis process. **V.** Salinity, Cousteau, Underwater, Bathyscaphe, Arctic–SCUBA **VI.** Have both these demonstrations performed for the class.

### Chapter 19

**I.** 1, 2 **II.** 1-3, 2-5, 3-6, 4-4 **III.** 1-c, 2-a, 3-a, 4-b **IV.** 1. temperature 2. light zone 3. salinity 4. Arctic 5. salinity **V.** 72 feet 2. 6 km deep **VI.** Post on the bulletin board. **VII.** Report to class.

### Chapter 20

**I.** 1, 4 **II.** 1. Sea cliffs are formed by wind erosion. 2. The water of a breaker rushes back under a new wave which is coming forward. 3. crest, trough 4. Warm moist air from the gulf stream hits the cooler air over London. Condensation takes place on the smoke particles and fogs are formed. **III.** 1-a, 2-d, 3-d, 4-b **IV.** 1. The form of the wave is up and down here. 2. Only those people in the way of the breakers are pushed toward the beach by them. 3. It is measured from crest to crest. 4. It is measured from crest to trough. **V.** 1. A ripple is formed by weak winds while a wave is formed by strong winds. 2. A breaker is the push of the water toward the land. An undertow is the return of the water to the sea. 3. Erosion is the wearing away of the land. Deposition is the building up of the land. 4. A bar is a deposit of sand that sticks out of the ocean. A causeway is the part of a bar that connects it to another land form or to the shore. **VI.** 1. Agree. Currents are formed by winds that are continuously moving in one direction. 2. Agree. They may take hundreds of years to form, as deposition is a very slow process. 3. Agree. The jetties prevent shore erosion. 4. Agree. The sun's rays are responsible for setting up different heat areas, which produce differences in air pressure, which produce winds, which produce waves.

### Chapter 21

**I.** 1, 3 **II.** 1-7, 2-4, 3-5, 4-7 **III.** 1-c, 2-a, 3-d, 4-c **IV.** 1. True. If they were not they could not survive. 2. True. They receive more sunlight there. 3. True. They contain air bladders so that they can float. **V.** Have students report the findings of 1 and 2 to the class. **VI.** Have students demonstrate their results to the class. **VII.** Report to class.

### Chapter 22

**I.** 1, 4 **II.** 1-8, 2-5, 3-4, 4-3 **III.** 1-a, 2-a, 3-c, 4-a **IV.** 1-a, 2-j, 3-d, 4-i, 5-e, 6-b, 7-h, 8-f **V.** 1. False. Each day, with increasing population on the earth, aquaculture is becoming a more valuable source of food. 2. True. However, it is a method of getting more lobsters to the market. 3. False. Each living thing in the ocean is part of the great food web. **VI.** Have these reports read in class.

### Chapter 23

**I.** 2, 3 **II.** 1. There would be a reduction of the lead pollution in the air and water. 2. There would be an increase in the pollution problem as this leads to putrefaction (rotting of algae by bacteria, fungi and oxidation). 3. The cesspool would become filled up more rapidly. The bacteria cause the decay of the solid wastes. **III.** 1-d, 2-a, 3-a, 4-a **IV.** 1. This would reduce oil pollution. 2. This would reduce air pollution. 3. This would help keep the streets cleaner. **V.** 1. to discover the effect of oil film on water life 2. The Elodea will die. 3. The Elodea did die. 4. Use detergents or skim off the oil with cotton balls. **VI.** Report to class **VII.** 1. Yes! It will oxidize and decay. 2. No! Those made from synthetic material are not organic and not biodegradable.

# CHEMISTRY 2—CHEMISTRY OF MIXTURES

### UNIT I: Chapter 1

**I.** 2, 4 **II.** 1-2, 2-3, 3-4, 4-1 **III.** 1-b, 2-a, 3-a, 4-d **IV.** 1. a. An iron ring is used for holding glassware that is being heated. b. A test tube rack is used for holding and drying test tubes. c. A test tube holder is used for holding a test tube while it is being heated. d. A mortar and pestle are used for grinding chemicals so that they can be dissolved faster. e. An evaporating dish is used to evaporate solvents in order to retain solutes. 2. a. In both experiments, electricity is used to make a chemical change. b. The experiment in Fig. 4-1 breaks down a compound into its elements. The experiment in Fig. 4-2 combines elements to make a compound. 3. The experiment would stop because the flow of current would stop. **V.** Teacher, caution the students to let you check the glassware before it is used. **VI.** 1. True. A laboratory has the best facilities for performing experiments. 2. False. New information can be discovered at a later date that may cause changes in the law. 3. True. The data can be incorrect.

### Chapter 2

**I.** 3, 4 **II.** 1. Parts of a mixture can be separated by physical means. 2. One can use any amount he or she desires. 3. Mixtures retain their individual properties; no new substances are formed, and no definite amounts are needed or used. 4. A painter mixes his paint with oil, turpentine and pigments. **III.** 1-a, 2-c, 3-a, 4-d **IV.** 1. Na (sodium), Cl (chlorine), H (hydrogen), Cu (copper), S (sulfur), 2. gold-element, carbon dioxide-compound, fat-compound, iron-element, iodine-element 3. burning gas, lighting a match 4. A pharmacist fills doctors' prescriptions. These must be precisely measured. A graduated cylinder and a weighing scale measure volume and weight. **V.** diet, rust, kerosene, iron, nitrogen gas–DR. KING **VI.** 1. Yes. The iron filings will be attracted to the poles of the magnet. 2. No. A mixture does not have definite amounts of substances. 3. Yes. Nickel is a substance that is attracted to magnets. 4. No. Both are attracted to magnets.

### UNIT II: Chapter 3

**I.** 2, 4 **II.** 1-6, 2-7, 3-7, 4-8 **III.** 1-a, 2-d, 3-c, 4-b **IV.** 1. No. You cannot see through paper. Most paper absorbs water. 2. This acts as a control, or check, on the experiment. **V.** Teacher, caution the students not to *taste* the solutions.

### Chapter 4

**I.** 2, 3 **II.** 1. No. We need other solvents like alcohol, carbon, tetrachloride, and chloroform for certain solutes. 2. The solvent for iodine is alcohol. 3. Yes. Hot lead dissolves tin to form solder. 4. The smaller the solute the faster is its rate of dissolving in a solvent. **III.** 1-a, 2-a, c, 3-c, 4-d **IV.** 1-d, 2-c, 3-g, 4-a, 5-e **V.** 1. element-compound, 2. solute-solvent, 3. chemical change-physical change

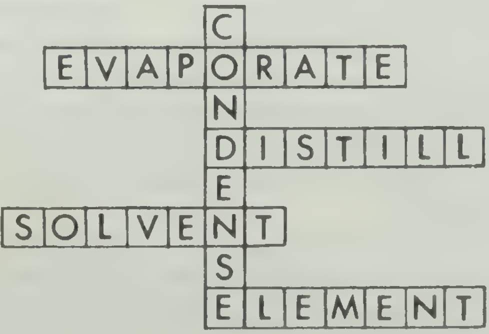
### Chapter 5

**I.** 1, 2 **II.** 1-2, 2-3, 3-8, 4-4 **III.** 1-a, 2-a, 3-b, 4-b **IV.** sAturated, solvEnt, dIlute, atOm, compoUnd –*A, E, I, O, U* **V.** 1. No, because there is only a certain amount of heat in the hot water. Only a fixed amount of sugar would therefore be dissolved. When you heat the jar with a Bunsen flame, however, you are adding more heat and you can, therefore, dissolve more and more sugar. 2. The $CuSO_4$ will dissolve faster if it is powdered but the *amount* of $CuSO_4$ that can be dissolved depends on the temperature. **VI.** Crystals of sugar will form because the cold water cannot hold as much sugar in solution as the warm water can.

### Chapter 6

**I.** 1, 3 **II.** 1. It is a physical change as no new substance is formed; only the phase of the substance is changed. 2. The solvent can be saved by condensing it back into the liquid phase. 3. Evaporation can be speeded up by increasing the temperature of the solution, or reducing the pressure over it. 4. The water from the ocean should be placed in shallow pools. Allow the water to be evaporated by the sun's heat. **III.** 1-d, 2-c, 3-d, 4-c **IV.** 1. Yes, but not as fast. The temperature of the water in the beaker is lower than the temperature of the steam. 2. Vapor. 3. It remains behind in Flask 1. 4. It is colorless. **V.** Stress the importance of using only harmless vegetable dye.

**VI.**



### Chapter 7

**I.** 1, 3 **II.** 1-9, 2-7, 3-5, 4-2 **III.** 1-b, 2-b, 3-d **IV.** 1. solvents 2. cool 3. granite 4. cobalt chloride 5. humidity **V.** 1. calcium chloride 2. salt 3. regular 4. physically **VI.** On humid days his beard will turn blue.

### Chapter 8

**I.** 1, 4 **II.** 1-2, 2-3, 3-5, 4-6 and 8 **III.** 1-a, 2-c, 3-d **IV.** 1. Rain water dissolves the dry fertilizers and the solution is absorbed by the roots of the plants. 2. Gravy (an oil) is not soluble in water. 3. Neither. The numbers refer to potassium, phosphorus, and nitrogen, all of which are soluble in water. **V.** Tell the students that bottles would be best. Stress the fact that all bottles should be labeled. **VI.** Both of these projects can be made up into attractive charts.

### UNIT III: Chapter 9

**I.** 2, 4 **II.** 1. In the solutions, the particles are molecules and are not visible. In suspensions, the particles are much larger and are visible. 2. No. The light is reflected off each particle in the suspension in the particle's own color. 3. Deltas are formed by sedimentary sand deposits which are transported by rivers in the form of suspensions. 4. The calamine powder is pink and its smallest particles remain suspended in the solution, giving its pink color. **III.** 1-a, 2-c, 3-d, 4-c **IV.** 1. Shake Bottle B until it looks like the contents of Bottle A. 2. a. The contents of Jar 4 would look like the contents of Jar 1. b. The contents would resettle in the same order as they originally were in Jar 4. **V.** 1. susPension 2. sOlution 3. molecuLe 4. mixturE 5. Sediment–*POLES* **VI.** 1. True. Shoe polish is a suspension of solids in a liquid. 2. True. The sugar dissolves in the water and colors the water brown. **VII.** 1. solvent, 2. ions, 3. energy, 4. copper

### Chapter 10

**I.** 2, 4 **II.** 1-6, 2-7, 3-4, 4-3 **III.** 1-a, 2-d, 3-a, 4-a **IV.** 1. The paint pigment would get mixed with the turpentine. Some of the pigment would also stick to the brush. The brush would have to be recleaned. 2. Practically no use at all. It is cheaper to buy new paint than to try to make paint from the saved pigment. **V.** 1-b, 2-c, 3-d, 4-e, 5-a **VI.** 1. Use milk or soda pop. 2. Paste the parts on a chart and label them. **VII.** The more finely ground "drip-grind" coffee will produce coffee that is ready to drink before the less finely ground "percolator-grind" coffee.

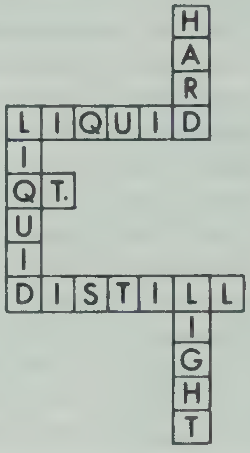
### Chapter 11

**I.** 1, 3 **II.** 1-2, 2-5, 3-6, 4-9 **III.** 1-a, 2-d, 3-d **IV.** 1. settle 2. sediment 3. liquids 4. dissolves 5. size 6. make even **V.** The shaving cream emulsifies the oil on a person's skin and water.

### Chapter 12

**I.** 2, 4 **II.** 1. Yes. Colloid particles pass through a filter. 2. They are suspensions of a liquid in a liquid. 3. the solid pigment in the liquid oil 4. Living matter is a colloid. The basic material of the living cell is a colloid. **III.** 1-a, 2-a, 3-d, 4-d **IV.** 1. true 2. cannot 3. do not settle 4. colloid 5. pigment **V.** 1. The water would take on the same color as in Cylinder A. But, the sand would continue to settle. 2. The sand would remain in the filter paper but the ferric chloride would pass through the filter paper.

**VI.**



**VII.** 1. Very few women were allowed to attend college. Yes, this story has already changed as many of our most famous scientists are and will be women, as more and more women go to college and major in science. 2. Have students read their reports and select highlights from each life.

### Chapter 13

**I.** 2, 4 **II.** 1-3, 2-3, 3-4, 4-1 **III.** 1-a, 2-b, 3-d, 4-c **IV.** 1. So that they will not pollute the wells which supply drinking water. 2. No. The water may come from a polluted source. 3. I would be a good citizen and bury the garbage. **V.** 1. and 2. Have the students make up a display of the booklets which are received.

### Chapter 14

**I.** 2, 3 **II.** 1-4, 2-3, 3-2, 4-5 **III.** 1-b, 2-d, 3-a, 4-d **IV.** 1. The fish would die as there is no oxygen dissolved in distilled water. 2. There are greater chances of more germs getting into swimming pool water. Therefore, you need more chlorine to kill these germs. 3. Distill the ocean water. **V.** 1-f, 2-d, 3-c, 4-b, 5-a **VI.** 1. Have the students report to the class on these two projects.

### Chapter 15

**I.** 1, 4 **II.** 1-5, 2-7, 3-3, 4-6 **III.** 1-b, 2-a, 3-a, 4-d **IV.** 1. The soap emulsifies the oil and makes it stick to the sand. This can then be swept away. 2. The natural oils in your hair have been washed away. 3. Soap contains lye which is weakened by water. This base burns your eyes. **V.** 1. aeraTion

2. deteRgent 3. impUrities 4. SeDiment 5. oxygEn 6. SoAp 7. emUlsion — *TRUDEAU*

**UNIT IV: Chapter 16**

**I.** 1, 2 **II.** 1. Yes. It is a very active metal. 2. The taste of acid is sour. 3. Blue litmus turns red when placed in an acid. 4. Henry Cavendish discovered the gas, hydrogen, and how to release it from an acid. **III.** 1-b, 2-d, 3-a, 4-a **IV.** 1. physical 2. strong 3. alcohol 4. less 5. colloid **V.** 1. One atom of hydrogen and one atom of chlorine, combined to form hydrochloric acid. 2. So that you can see the water being replaced by the hydrogen gas. Thus, you will know when the gas is collected. 3. The hydrogen comes from the HCl. 4. The thistle tube allows the acid to come into contact with the zinc. 5. We could pour the acid directly onto the zinc and use a one-holed stopper for the delivery tube. This method is not very safe, however. **VI.** 1. The color becomes blue indicating a base. The blue color turns red indicating an acid. 2. The color turns blue as ammonia water is a base. The color turns red as alum becomes acidic in a water solution.

**Chapter 17**

**I.** 3, 4 **II.** 1-2, 2-4, 3-2, 4-5 **III.** 1-a, 2-a, 3-c, 4-d **IV.** 1. False. Milk of magnesia is a base and is used as a laxative. 2. True. It contains oxygen and hydrogen. 3. True. When sodium is placed on water it is so active that it releases the hydrogen from the water. 4. True. This is the litmus indicator test for bases. **V.** Have the students report to their classmates on their findings. **VI.** 1. colloid 2. oxide 3. radium 4. nitrogen 5. energy 6. lye 7. liquid–*CORNELL*

**Chapter 18**

**I.** 2, 4 **II.** 1-5, 2-6, 3-3, 4-5 **III.** 1-a, 2-d, 3-b, 4-a **IV.** 1-f, 2-b, 3-d, 4-c, 5-a **V.** 1. $HNO_3$ 2. NaCl 3. potassium hydroxide 4. sodium hydroxide **VI.** 1. True. $HCl + NaOH \rightarrow NaCl + H_2O$. 2. False. Any acid plus any base can cause neutralization. Both vinegar and hydrochloric acid, however, are acids. 3. True. It produces a salt plus water.

**Chapter 19**

**I.** 2, 4 **II.** 1. Ions are atoms or groups of atoms that have an electric charge. 2. By plating. Plating is the process by which one metal is deposited on the surface of another metal by an electric current. 3. No, some electrolytes are stronger than others. The stronger the electrolyte, the better the conductor of electricity it is. 4. When a current is passed through $Al_2\ O_3$ (bauxite) the $Al_2\ O_3$ breaks down into $Al^+$ ions which are drawn to the negative electrode and become Al atoms. **III.** 1-a, 2-d, 3-a, 4-d **IV.** Note: *Ore* should be included in the list of words. 1. charged 2. electrolysis 3. ore 4. negative 5. salts **V.** 1. The salt helps with the conduction of the electric current through the water. The electric current heats the water. 2. Attach the "silver" quarter to the negative electrode. On the anode place a copper bar. Place both into a bath as in the setup in Fig. 116-1. The copper will be plated onto the quarter. **VI.** 1. base 2. negative ion 3. condensation 4. compound 5. solute

**Chapter 20**

**I.** 2, 4 **II.** 1-5, 2-6, 3-2, 4-7 **III.** 1-b, 2-d, 3-b, 4-d **IV.** 1 true 2. laxative 3. true 4. true 5. true **V.** Ask the students to bring in samples of each chemical mounted on a chart. **VI.** Have the students report to the class on the results of the test.

**Chapter 21**

**I.** 1, 3 **II.** 1. These are the boiling and freezing temperatures of water. 2. No. It takes time for the water to completely change to ice. 3. When all the water has changed to ice. 4. No. It remains at 100°C. All the water is changed to steam. **III.** 1-a, 2-b, 3-c, **IV.** 1. True, but you will not be able to make a graph. 2. True. Water cannot be heated above 100°C. 3. True. If the heating continues, all the water will change to steam. **V.** 1. cycle 2. vapor 3. Celsius 4. axis 5. distilled

**VI.** It was called the Centigrade thermometer because *centi* means 100 and there are 100° between the freezing and boiling points on the thermometer. 2. 63°C.

**Chapter 22**

**I.** 1,4 **II.** 1-6, 2-4, 3-2 **III.** 1-c, 2-a, 3-a, 4-d **IV.** 1. 100, 2. 37°C, 3. 100°C, 4. 2, 5. 3 **V.** 1. The greater the ratio of alcohol to water, the lower the temperature must be before the water in the car radiator will freeze. 2. (Same as 1.) 3. Kerosene has a lower freezing point than water. Therefore, if there is kerosene in the flush tank, the pipes will not burst during a cold winter. **VI.** The results should show the solutions freezing in this order: 1-a, 2-d, 3-c, 4-b

# PHYSICS 2—MATTER AND ENERGY

**UNIT I: Chapter 1**

**I.** 3, 4 **II.** 1-6, 2-3, 3-4 **III.** 1-c, 2-d, 3-c, 4-b **IV.** 1. False. All scientists have to have backgounds in all the sciences. 2. False. He has to learn all about the chemicals that are used in the tubes. 3. False. A good scientist keeps up to date in all the sciences. **V.** 1-P, 2-A, 3-G, 4-C, 5-P, 6-P, 7-G, 8-B, 9-B, 10-P **VI.** Read and discuss reports in class.

**Chapter 2**

**I.** 1, 3 **II.** 1. No. He can study it all around himself. 2. It originated in France. 3. They are very important for precision of measurement. **III.** 1-b, 2-b, 3-b, 4-c, **IV.** 1. energy 2. measurements 3. senses 4. instruments 5. observations 6. metric **V.** 1. True. The more sophisticated the instruments the more precise the readings. 2. False. A good scientist usually observes what happens and then experiments to test new ideas. 3. False. A good scientist sets up a hypothesis before he starts his experiment.

**Unit II: Chapter 3**

**I.** 2, 3 **II.** 1. chemical, heat, and motion 2. nuclear energy 3. muscular energy 4. nuclear energy **III.** 1-d, 2-d, 3-a, 4-c **IV.** 1. The golf ball, because of its greater weight, would not vibrate as freely as the Ping-Pong ball. 2. This is dangerous. After sufficient pressure is built up in the flask the cork will shoot out. **V.** 1. Have the students read their reports to the rest of the class. 2. Have the students show their water wheels to the rest of the class. 3. Demonstrate to the class.

**Chapter 4**

**I.** 1, 4 **II.** 1-4, 2-6, 3-3, 4-6 **III.** 1-a, 2-b, 3-a, 4-a **IV.** 1. potential 2. oxidize 3. reservoir 4. kinetic 5. carbon 6. heat 7. ore 8. precise—PORKCHOP **V.** 1. The stopper prevents the gas from leaving the can. 2. Tongs will keep your hand far enough away from the explosion to keep it from being burned. 3. The pressure would build up great enough to blow the stopper out. **VI.** 1. There is a catch that keeps the roller spring wound until it is released. 2. Make certain students get an old clock which is not in use any more.

**Chapter 5**

**I.** 1, 3 **II.** 1. Light from the sun causes electrons to move from the selenium, which causes the cell to act like a battery. 2. Yes. This is shown by a radiometer. 3. Gravity is the force which pulls objects toward the earth's center. **III.** 1-b, 2-a, 3-c, 4-b **IV.** The greater the amount of radiation it receives the faster the blades of the radiometer will rotate. It will, therefore, rotate fastest in bright sunlight and slowest, if at all, in darkness. **V.** 1. This figure represents the mass of the metal or head of the hammer. The ordinary hammer is about 500 g. 2. The boy is right. When the glucose in the chocolate is oxidized the potential energy becomes kinetic energy.

**Chapter 6**

**I.** 2, 3 **II.** 1-3, 2-2, 3-6, 4-7 **III.** 1-b, 2-d, 3-a, 4-c **IV.** 1. decelerate 2. kinetic 3. physical 4. condensation 5. freezing

**Chapter 7**

**I.** 1, 3 **II.** 1-2, 2-7, 3-1, 4-6 **III.** 1-d, 2-b, 3-c,4-d **IV.** 1. Its inertia keeps it going. 2. The object is being pulled to the center of the earth by the force of gravity. 3. The force of gravity is proportional to the mass and the acceleration of a body. Therefore, the acceleration is equal to the force ÷ mass. As the mass increases, the force also increases. Therefore, the acceleration remains the same. **V.** Have students report on these scientists to the rest of the class. **VI.** enerGy, cRystal, dAm, Volcano, Inertia, moTion, hYdrogen–GRAVITY

**Chapter 8**

**I.** 1, 2 **II.** 1. We use a method of comparison using gravity. We compare the downward pull of gravity on the object being weighed with the force of gravity pulling on an object whose mass we know. 2. Its resolution is limited to the smallest mass which is available. 3. usually numbers of grams or kilograms **III.** 1-3, 2-b, 3-c, 4-c **IV.** 1. 630 2. 40 3. 3 **V.** 1. False. Even though the feathers make take up more volume than the lead, the mass is the same. 2. False. The paper will land after the pencil because of air friction. It is only in a vacuum that all matter will fall at the same speed. **VI.** 1. yes 2. no 3. yes 4. no **VII.** A "stone" equals 14 pounds. Divide your mass in pounds by 14 pounds and the answer is your mass in "stones". **VIII.** 1. Demonstrate to the class. **IX.** The spring stretches and loses its tension.

**Chapter 9**

**I.** 3, 4 **II.** 1-2, 2-5, 3-6, 4-6 **III.** 1-b, 2-c, 3-d, 4-a **IV.** 1. mAss 2. volumE 3. equIlibriUm

4. fOrce–A, E, I, U, O **V.** 1. R = 40 lbs. in the same direction as the 2 forces. 2. The floor must push up with a force of 10 t to support the bricks. **VI.** Have the students show their drawings to the rest of the class.

### Chapter 10

**I.** 1, 4 **II.** 1-3, 2-4, 3-6, 4-1 **III.** 1-b, 2-c, 3-a, 4-d **IV.** 1-h, 2-a, 3-c, 4-d, 5-f, 6-b, 7-j, 8-i **V.** 1. Less at the equator than at the South Pole. The objects at the equator at sea level are 21 km farther from the center of gravity of the earth than objects at sea level at the South Pole. 2. It will fall over if its center of gravity falls outside of its base. **VI.** 1. In this demonstration be careful to note that the material to be weighed and the masses are of different densities. You can show the differences in buoyancy that will occur. 2. Try to get a photo of these scales. **VII.** 1. No. We just change one form of energy into another. 2. Yes. It changes the potential energy of the oil into kinetic energy.

### UNIT III: Chapter 11

**I.** 2, 4 **II.** 1-3, 2-4, 3-5 **III.** 1-d, 2-d, 3-a, 4-a **IV.** Note that when you lift weights, the input force is almost the same as the mass. However, it does not matter how fast you lift the mass. The amount of work done is constant for the same mass through the same distance. **V.** 1. inertia 2. true 3. true 4. true 5. gravitation

### Chapter 12

**I.** 1, 2 **II.** 1-4, 2-6, 3-3, 4-4 **III.** 1-a, 2-c, 3-d, 4-b **IV.** 1. time 2. rate 3. per minute 4. machines 5. direction 6. speed 7. energy

### Chapter 13

**I.** 2. 3 **II.** 1-3, 2-2, 3-5, 4-3 **III.** 1-b, 2-a, 3-b, 4-d **IV.** 1. He will add this pipe to the wrench handle and so increase its lever arm. 2. The 75 kg boy will move closer to the fulcrum until the boys are evenly balanced. **V.** 1. False. The tweezer has the effort applied between the fulcrum and the resistance. The nutcracker has the effort at one end, the resistance in the center, and the fulcrum at the other end. 2. True. The effort arm is longer. 3. False. You are really using a combination of an inclined plane to force the door apart and a lever when you pry the door open. **VI.** Display these posters on the science bulletin board.

### Chapter 14

**I.** 2, 3 **II.** 1-2, 2-2, 3-4, 4-5 **III.** 1-c, 2-a, 3-a, 4-d **IV.** 1. The pliers can act as the wheel. 2. If the gear ratio is the same, then there will be nothing gained. **V.** Have students bring the finished product into class and discuss it with the other students.

**VI.** 1. A. ⅓ kg to balance the 2 kg

$$\text{M.A.} = \frac{\text{Effort distance}}{\text{Resistance distance}} = \frac{60\text{ cm}}{10\text{ cm}} = 6$$

B. 2 kg to balance the 8 kg

$$\text{M.A.} = \frac{\text{E.D.}}{\text{R.D.}} = \frac{60\text{ cm}}{15\text{ cm}} = 4$$

2. Have students report their findings to the class.

### Chapter 15

**I.** 2, 3 **II.** 1. No, it only gives a 1 to 1 ratio. 2. Work out the M.A. of the system. 3. The pulley wheel turns freely on an axle. The wheel and axle turn together. 4. The movable pulley is the one attached to the resistance. **III.** 1-b, 2-a, 3-d,

### Chapter 16

**I.** 1, 2 **II.** 1-4, 2-4, 3-2, 4-3 **III.** 1-a, 2-c, 3-b, 4-b **IV.** 1. always fixed 2. around the axle 3. can be created but not destroyed 4. never increase energy 5. 1000 W 6. the resistance **V.** 1. Each tooth forms a large wedge and helps make the cutting of the tree easier. 2. As it leans against the wall it forms a ramp and it is easier for a person to go up this ladder. When the ladder is straight up against the wall, a person has to exert a greater force in lifting anything up the ladder.

**VI.** (a) $\text{M.A.} = \frac{L}{H} = \frac{30}{15} = 2$

Therefore, one needs to exert only 2500 N of force over 30 m to push the cart up the inclined plane.

**VI.** (a) $\text{M.A.} = \frac{L}{H} = \frac{120}{30} = 4$

Therefore one needs only to exert 1250 N of over 120 m to raise the cart up the inclined plane.

### Chapter 17

**I.** 3, 4 **II.** 1. A screw with many threads takes longer and decreases the speed. 2. 3 3. It has a screw to apply pressure. 4. The screw part. **III.** 1-d, 2-a, 3-b, 4-d **IV.** Have students discuss their reports with the rest of the class. **V.** 1. wheels and axles, gears 2. wheel and axle, screw 3. wedge, lever 4. lever, wedge **VI.** wheel, kilogram, fulcrum, potential–WORK needs FORCE

### Chapter 18

**I.** 2, 4 **II.** 1-2, 2-3, 3-7, 4-3 **III.** 1-c, 2-d, 3-d, 4-a **IV.** 1. False. Rust increases friction. 2. True. Grease will not evaporate. 3. True. Rubber produces more friction than leather. **V.** 1. compound 2. efficiency 3. friction 4. heat 5. reduces 6. output 7. input 8. percent **VI.** 1. The picture is of an experiment showing how rollers reduce friction. 2. The spring balance measures the force used to pull the box with and without pencils (rollers). 3. Pencils work better than ball bearings but you can use ball bearings.

**UNIT IV: Chapter 19**

**I.** 1, 2 **II.** 1-6, 2-7, 3-9, 4-3 **III.** 1-c, 2-c, 3-a **IV.** 1. 400 containers are needed 2. Mass of 1 L of water = 1 kg Mass of tank = 60 + 5 = 65 kg **V.** 1. As a person gets into the bathtub water, he displaces a volume of water equal to his own volume. Therefore, unless there is an overflow opening near the top, the water will flow over the top of the tub. 2. Silver has a greater density than iron and therefore will displace less water than the iron and silver combination.

**Chapter 20**

**I.** 2, 4 **II.** 1. pascals ($N/m^2$) 2. At the same level, the pressure in all directions is the same. 3. Area is the extent of surface; water pressure is the force on every unit area. 4. The pressure is increased because of the height of the tanks. **III.** 1-c, 2-a, 3-d, 4-c, **IV.** 1. potential 2. F × D 3. energy 4. power 5. Einstein 6. solar energy 7. mass 8. position **V.** 1. Yes. First weigh the empty quart can on the spring scale. Then weigh the litre can filled with water. Subtract the mass of the empty can from the total mass. The answer will be the mass of the litre of water. 2. Find out how many litres of water will fill the 2 $dm^3$ tank and divide the mass by 2 to get the mass of one litre of water. **VI.** Weigh a litre of milk and a litre of water. Compare masses. The milk is less dense than water. **VII.** The cardboard carton will not work in the experiment. The paper will absorb water. **IX.** Demonstrate to class.

**Chapter 21**

**I.** 2, 3 **II.** 1-4, 2-3, 3-4, 4-2 **III.** 1-b, 2-b, 3-b 4-a **IV.** 1. Have students read their reports to the rest of the class. 2. Caspian Sea, Dead Sea, Great Salt Lake, Red Sea, Sea of Tiberias, Lake Chad, Aral Sea **V.** The teacher can demonstrate 1 and 2 to the class. **VI.** *Across* 1. arm 3. buoyancy 5. sun 8. iron 9. seesaw *Down* 2. Mrs. 3. Bunsen 4. dam 5. cubic 7. ear

**Chapter 22**

**I.** 2, 4 **II.** 1. so that the submarine can move up or down in the water 2. They greatly increase a person's volume while only increasing mass a little. Therefore, the person has greater buoyancy. 3. Open up the valve to let the gas out of the balloon. 4. It sinks until it displaces a volume of water equal in mass to the ship's mass. **III.** 1-a, 2-c, 3-b, 4-d **IV.** 1. floating and sinking 2. buoyancy 3. displaces 4. volume 5. buoyancy 6. helium 7. explode **V.** 1. Have the students label each and demonstrate. 2. Have a student read his report to the rest of the class.

# BOOK 3 SERIES

# BIOLOGY 3—THE NEXT GENERATION

### UNIT I: Chapter 1

**I.** 1, 2 **II.** 1-8, 2-4, 3-3, 4-2 **III.** 1-a, 2-c, 3-d, 4-a **IV.** 1. oxygen 2. carbon 3. 80% 4. 5 5. Mixture–it has no definite amount. Heat appears in all living matter. **V.** 1. Charles Darwin was then able to set up a system of bird classification for these islands according to the likenesses of the birds that lived there. 2. At the zoo you can see many of the members of the Tree of Life and see how they compare with one another. 3. "Maple" tells us the genus but not the species. We also have to know if it is a red maple or a sugar maple, etc. **VI.** Have students report their results to the rest of the class. **VII.** 1. Set up a bulletin board to exhibit these picture collections. 2. Dewey decimal numbers: Botany–630.2A. Zoology– 591. Genetics–575.1.

### Chapter 2

**I.** 2, 3 **II.** 1. We shall study reproduction and many of the ideas related to it. 2. DNA is deoxyribonucleic acid which is a nucleic acid. 3. Genetics is the science of heredity. 4. the nucleus **III.** 1-a, 2-a, 3-c, 4-a **IV.** 1. mongrel–usually an animal resulting from the crossing of different breeds. 2. hybrid–the offspring of two living things of different breeds. 3. mutt–a mongrel dog. 4. thoroughbred–an animal of pure breed. **V.** 1. cytoplasm–the living substance of a cell exclusive of the nucleus. 2. nucleus–controls all life activities of a cell. 3. cell membrane–the living part of the protoplasm that covers a cell. 4. cell wall–the dead part (cellulose) of a plant that covers a cell. 5. vacuoles–food reservoirs, digesters and eliminators of waste. **VI.** 1. species 2. sexual 3. heredity 4. genetics 5. nucleus 6. nucleic acids **VII.** Have students report to the rest of the class.

### UNIT II; Chapter 3

**I.** 1, 4 **II.** 1-4, 2-5, 3-6, 4-3 **III.** 1-c, 2-a, 3-b, 4-b **IV.** 1. This is so they cannot be contaminated by outside bacteria. 2. This makes it easier to see the bacteria. 3. This allows the proper temperature to be maintained. 4. Keep one petri dish outside the incubator and compare the growth of bacteria there with the dish inside the incubator. 5. Your fingers may have bacteria on them and so contaminate the agar. Also you could become infected. 6. The chromatin in bacteria is scattered throughout the cytoplasm. **V.** 1. nucleus 2. living matter 3. protozoa 4. fungi 5. chlorophyll **VI.** Explain your results to your class.

### Chapter 4

**I.** 1, 4 **II.** 1-6, 2-8, 3-6, 4-5 **III.** 1-b, 2-b, 3-a, 4-a **IV.** 1. The yeast needs a warm temperature for reproduction. 2. The contents will not be contaminated by organisms in the air. 3. Pass the gas into limewater and if the limewater turns milky white then you know that the gas is $CO_2$. 4. (a) Any gases produced by the solutions will contact the limewater. (b) This is done to check if $CO_2$ gas is given off. **V.** 1. Baking powder is a substitute for yeast. It contains $NaHCO_3$ which sets $CO_2$ gas free when it is moistened. 2. It is mixed with the flour and water. 3. It produces $CO_2$ gas which leavens the bread. **VI.** Exhibit and report to the class. **VII.** Demonstrate your results to your class.

### Chapter 5

**I.** 1, 4 **II.** 1. Repeat Investigation 5. 2. It absorbs digested food from the material on which it grows. 3. Penicillin, streptomycin, cheese makers, other antibiotics 4. Thousands of spores can be produced whereas fission produces only 2 at a time. **III.** 1-c, 2-a, 3-b, 4-a **IV.** 1. True. Spores are prevented from getting into a covered jar. 2. True. You stop the source of energy for reproduction. 3. True. The temperature of the room has to be optimal and the air has to contain spores. 4. True. It will grow only if it can digest the starch in the paper. **V.** 1. sexual 2. chlorophyll 3. antibiotics 4. $C_2H_5OH$ 5. beer 6. yeast 7. agar 8. sterilization **VI.** Refrigeration controls the growth of molds.

### Chapter 6

**I.** 1, 3 **II.** 1-7, 2-3, 3-4, 4-7 **III.** 1-a, 2-b, 3-c, **IV.** 1. False. It is really the stem of the plant. 2. True. Its starch content is changed into sugar to provide energy for the growth of the plant. 3. False. Bulbs are thick leaves of buds. 4. True. The sap would evaporate. **V.** 1. asexually 2. leaves 3. roots 4. vegetative 5. bulbs 6. stems 7. parent **VI.** Have students bring in their results.

### Chapter 7

**I.** 1, 3 **II.** 1-2, 2-3, 3-5 **III.** 1-a, 2-c,
**IV.**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Y | E | A | S | T | | | | |
| | | | | T | U | B | E | R | S |
| | | P | L | A | N | A | R | I | A |
| | | | | R | O | O | T | S | |
| | | | | F | U | N | G | I | |
| B | U | D | D | I | N | G | | | |
| | | F | I | S | S | I | O | N | |
| | | | | H | Y | D | R | A | |

### Chapter 8

**I.** 1, 4 **II.** 1. They have only 8 chromosomes in the nucleus of the body cells. They are easy to grow. 2. It divides in two and each half goes into the new cell formed. 3. It causes the duplication of the chromosome. 4. In the nucleus and the cytoplasm **III.** 1-a, 2-d, 3-c, 4-c **IV.** 1. True. Human. 2. False. Both have red eyes. 3. True. Both start from a single cell. 4. False. Fruit flies reproduce sexually. **V.** 1. cytoplasm 2. spores 3. $CO_2$ 4. sugar 5. vegetative 6. stem 7. regeneration 8. genetics **VI.** Have students report their results to the rest of the class. **VII.** Post on the bulletin board.

### UNIT III: Chapter 9

**I.** 3, 4 **II.** 1-5, 2-8, 3-4, 4-3 **III.** 1-a, 2-c, 3-c, 4-a **IV.** 1. True. It started out its life as a fertilized egg cell. 2. False. An egg has half the number of chromosomes. 3. True. A sperm has half the usual number of chromosomes. 4. True. First mitosis takes place, then chromosomes line up in 2 parallel planes and reduce to haploid number. **V.** 1. gamete 2. cell 3. reproduction 4. reproduction 5. vegetative propagation 6. fermentation **VI.** Have students report to the rest of the class. **VII.** Have students report to the rest of the class.

### Chapter 10

**I.** 1, 3 **II.** 1-4, 2-4, 3-2, 4-5 **III.** 1-a, 2-d, 3-d, 4-b **IV.** 1. True. Otherwise the parents will eat their young. 2. True. In a hatchery they are removed from most of their natural enemies. 3. True. It is the combination of sperm (X) + egg (X) = 2X. 4. False. It uses both meiosis and mitosis. 5. False. Only the female has the eggs or roe (caviar). **VI.** 1. Eggs are produced by females, sperms are produced by males. 2. Mitosis is the process by which each chromosome separates into 2 parts and produces daughter cells with a diploid number. Meiosis is the process by which the diploid number becomes the haploid number. 3. Roe is the egg of a fish whereas milt is the sperm of a fish. 4. The ovary produces the egg. The testis produces the sperm. 5. The zygote is the fertilized egg with 2X number of chromosomes from which the embryo or young organism develops. **VII.** Have students bring the fish into class and demonstrate their findings.

### Chapter 11

**I.** 2, 4 **II.** 1. The tail of the tadpole gets shorter, small hind legs appear, the gills begin to shrink; front legs appear, gills disappear and lungs form. 2. They get it from the egg. 3. A turtle's egg is fertilized in the body of the mother. 4. It is a large egg. **III.** 1-d, 2-b, 3-b, 4-a **IV.** 1-j, 2-i, 3-a, 4-d, 5-b, 6-c, 7-e, 8-f **V.** sperm, mitosis, embryo, laboratory, testes–SMELT **VI.** Have students report to the rest of the class.

### Chapter 12

**I.** 1, 4 **II.** 1-4, 2-6, 3-8, 4-6 **III.** 1-d, 2-b, 3-a, 4-d **IV.** 1. True. The blood spot tells us that it is a fertilized egg. 2. False. The egg does not have enough food to feed two embryos. 3. True, if they are fertilized. Usually, however, they are not fertilized. 4. False. An ostrich cannot fly. 5. False. A chicken is a warm-blooded animal with a temperature of 38 °C at most times. **V.** 1. backbone 2. feathers 3. hawk 4. poultry 5. meat 6. stored food **VI.** Have students bring their results into class.

### Chapter 13

**I.** 1, 4 **II.** 1-3, 2-4, 3-4, 4-8 **III.** 1-b, 2-c, 3-c, 4-b **IV.** 1. The embryo is the undeveloped and unborn organism. The infant is the newborn young organism. 2. The placenta is the membrane which narrows down to form the umbilical cord which in turn feeds the embryo. 3. A cold-blooded animal's temperature changes with the environmental temperature. A warm-blooded animal's temperature remains constant. 4. X represents the haploid number of chromosomes found in the sperm or egg, whereas 2X is the diploid number found in the zygote. 5. A vertebrate is an animal which has a backbone. An invertebrate does not. **V.** 1. False. Unfertilized eggs dissolve and are discharged from the uterus. 2. False. Only bird eggs are covered with a shell as the yolk of the egg feeds the embryo. 3. True. 4. True. **VI.** Report to class.

### Chapter 14

**I.** 1, 4 **II.** 1. A caterpillar is the undeveloped or larva stage of a butterfly. 2. They breathe through small openings in their abdomen called spiracles. 3. Insects have internal fertilization. 4. The pupa develops and changes into a moth. **III.** 1-b, 2-b, 3-d, 4-a **IV.** 1. The wrigglers are unable to break through the oil film for air. 2. The cocoon is the protection for the developing stage, or pupa. 3. The temperature is too low for their life activities. 4. They look almost like the adults. **V.** 1. fertilizes 2. gills 3. food for the embryo 4. air space 5. albumen 6. Columbia River 7. water 8. 21 **VI.** Have students demonstrate their findings to the rest of the class.

### Chapter 15

**I.** 2, 4 **II.** 1-3, 2-3, 3-4, 4-6 **III.** 1-a, 2-a, 3-b, 4-d **IV.** 1. The workers do not reproduce; only the Queen produces the eggs fertilized by the drones. 2. The drones neither work nor produce anything for the hive. 3. Some contain honey; some contain grubs; some contain royal jelly. Each has a special function. 4. The drone's sperm remains inside the Queen's body and is used to fertilize her eggs. 5. The ants have many tunnels and escape exits built into their anthills. **V.** 1-h, 2-i, 3-f, 4-d, 5-b, 6-a, 7-j, 8-g **VI.** Have students present their reports to the rest of the class.

### Chapter 16

**I.** 1,2 **II.** 1-6, 2-7, 3-6, 4-3 **III.** 1-a, 2-c, 3-a
**IV.** 1. flower 2. ovary 3. stamen 4. ovule
**V.** 1. False. Pollination is the process of bringing the sperm to the egg. 2. False. Some can attract insects by their odor. 3. False. Only one fertilization per ovule can take place. 4. True. Only one fertilization per ovule can take place.
**VI.** 1. The stamen is the male sex organ of a flower; the pistil is the female sex organ. 2. The ovary is the swollen part of the pistil which contains the ovules, or eggs, of a flower. 3. A flower is a ripened bud. 4. A sperm is a male gamete; an egg is a female gamete. 5. The transfer of pollen from the stamen to the pistil is pollination. The entrance of a sperm into an egg is fertilization. **VII.** Post these drawings on the bulletin board. **VIII.** Display these catalogs in the classroom.

### Chapter 17

**I.** 1, 4 **II.** 1. It was an unfertilized ovule. 2. It is an enlarged plant ovary with seeds. 3. Moisture and warmth 4. It was the ovary. **III.** 1-d, 2-b, 3-b, 4-a **IV.** 1. We are showing that water is needed for germination of seeds. 2. We do this in order to keep the blotter wet so that the seeds have a constant supply of water. 3. Yes. We would then water the blotter from time to time. 4. They hold the water.
**V.**

```
  S T A M E N     O
  E               V
C E L L           U
  D I S P E R S A L
                  E
      A B S O R B
  E             A     A
  G E R M I N A T I O N
  G                   T
```

**VI.** 1. sexual 2. sperm cells 3. egg cells 4. ovule 5. fruit 6. wind or water 7. germinate 8. water

### UNIT IV: Chapter 18

**I.** 1, 2, **II.** 1-3, 2-6, 3-4, 4-5 **III.** 1-d, 2-a, 3-b, 4-c
**IV.** 1. Chromosomes are the threadlike structures in the nucleus of cells which contain the genes, or hereditary factors. 2. Breeding is the choosing of parents for reproduction. This is done after a study of pedigrees, or family records. 3. Mitosis is the cell-division process which produces daughter cells. Each chromosome separates into 2 parts and produces cells with a diploid number (2X). Meiosis is the cell-division process by which the diploid number becomes the haploid number (X) in the production of sperms and eggs. 4. Genetic traits are inherited through the genes by reproduction. Environmental traits are developed by changes in the environment. These are not inherited.
**V.**

```
    G E |N| E
        |A| L G A E
C H R O |M| O S O M E
      B |A| C T E R I A
    M I |T| O S I S
        |H| E R E D I T Y
```

**VII.** Discuss several pedigrees with the class.

### Chapter 19

**I.** 1, 4 **II.** 1. parents which are not pure for a certain trait 2. The results are 50% hybrid, 25% pure dominant and 25% pure recessive traits. 3. No! Some are hybrid tall. 4. from its parents
**III.** 1-a, 2-b, 3-a, 4-a **IV.** 1. true 2. all 3. nineteenth 4. pure 5. true
**V.** 1.

|   | Y | y |
|---|---|---|
| Y | YY | Yy |
| y | Yy | yy |

Y = yellow-dominant
y = green recessive
25% pure dominant yellow
50% hybrid yellow
25% pure recessive green

2.

|   | H | H |
|---|---|---|
| h | Hh | Hh |
| h | Hh | Hh |

H = without horns-dominant
h = with horns–recessive
100% without horns hybrid

**VI.** 1614 total flies produced
396 short-winged
$\frac{396}{1614} = 1/4$ or 25% short-winged. Therefore,
75% are long-winged–L long-winged must be dominant and l short-winged recessive. Thus 2 hybrids may have been mated.

|   | L | l |
|---|---|---|
| L | LL | Ll |
| l | Ll | ll |

75% long-winged
25% short-winged

**Chapter 20**

**I.** 2, 3 **II.** 1-3, 2-5, 3-4, 4-6 **III.** 1-b, 2-b, 3-b, 4-a **IV.** 1-h, 2-g, 3-c, 4-j, 5-e, 6-a, 7-f, 8-b

**V.**

| Hybrid<br>Brown-eyed<br>Male Parent | Pure<br>Blue-eyed<br>Female Parent |
|---|---|
| Bb | bb |

Bb Bb bb bb

The chances are 50-50 for blue-eyed children.

**Chapter 21**

**I.** 2, 4 **II.** 1-2, 2-4, 3-3, 4-5 **III.** 1-b, 2-a, 3-b, 4-d **IV.** Have students report to the rest of the class. **V.** 1. Many more men than women die at those ages of heart failure and cancer. Also, many young men lost their lives during World War II. 2. Man propagated the seedless oranges by grafting. 3. Not very well. In his natural environment of snow and ice, he would be easily seen by his enemies and prey. 4. Yes. If mutations are formed by X-rays or some form of radiation. **VI.** 1. heredity 2. sperm 3. 46 4. pink 5. different 6. genes 7. dominant 8. DNA **VII.** Have students report to the rest of the class.

**Chapter 22**

**I.** 1, 3 **II.** 1-5, 2-1, 3-3, 4-4 **III.** 1-b, 2-d, 3-d, 4-a

**IV.**

Code

N: normal, dominant
H: hemophilia, recessive
o: no gene
$X^NX^N$ normal female
$X^NX^H$ normal female, hybrid
$X^NY^0$ normal male
$X^HY^0$ male with hemophilia

CROSS NO. 1
Man with Hemophilia X Normal woman

| | $X^N$ | $X^N$ |
|---|---|---|
| $X^H$ | $X^NX^H$ | $X^NX^H$ |
| $Y^0$ | $X^NY^0$ | $X^NY^0$ |

CROSS NO. 2
Normal Man X Normal-Looking Woman (Hybrid)

| | $X^N$ | $X^H$ |
|---|---|---|
| $X^N$ | $X^NX^N$ | $X^NX^H$ |
| $Y^0$ | $X^NY^0$ | $X^HY^0$ |

**V.** 1. He is wrong. No one is really "too dumb to learn." The clearance of the slums would help create a better environment in which people would have a better incentive for learning. 2. The girl is wrong. Brown eyes are dominant over blue eyes. Therefore at the most, 50% of the children will be blue-eyed, if the man is hybrid brown-eyed. If the man is pure brown-eyed, then all the children will have brown eyes. 3. He may be correct. If they are fraternal twins and were developed from different eggs, they would not necessarily look alike.

**VI.**

H Y B R I D
D O M I N A N T
E M B R Y O
M E I O S I S
P I S T I L
T R A I T
P U P A
T W I N
N E G R O I D
G E N E

**VII.** Have students report their findings to the rest of the class.

**Chapter 23**

**I.** 1, 4 **II.** 1. To develop living things which will produce more fruit, etc, or meat, etc. 2. It may result in the best traits of both animals. 3. It is a process of breeding by which the best traits of each living thing is selected for continued breeding. 4. Yes! By means of chemicals and radiation. **III.** 1-a, 2-c, 3-c, 4-a **IV.** 1. The breeders will select the animals and plants that will produce the largest amounts of food and carefully breed them. 2. He may have many of the worthwhile traits of all the animals involved in his pedigree. 3. We breed them by vegetative propagation (grafting). **V.** 1. A cattalo is a hybrid resulting from the crossing of an American bison (buffalo) with a domestic cattle. 2. A mule is the offspring of a male donkey and a female horse (mare). A mule cannot reproduce. 3. Merino sheep is a breed of sheep which produces fine wool. **VI.** Read to class. **VII.** 1. sheep 2. cattle 3. orange 4. fox 5. breeding

# EARTH SCIENCE 3—MAN AND ENERGY IN SPACE

**UNIT I: Chapter 1**

**I.** 1, 3 **II.** 1-8, 2-9, 3-6, 4-4 **III.** 1-c, 2-a, 3-c, 4-d **IV.** 1. planet 2. atmosphere 3. lithosphere 4. hydrosphere 5. forces of nature 6. heat 7. chemical 8. sun **V.** 1. temperature 2. energy 3. lithosphere 4. electron 5. star 6. core 7. oxidation 8. planet 9. engine–TELESCOPE

**Chapter 2**

**I.** 1, 3 **II.** 1. Astrology is a pseudo-science that studies the stars in relation to their so-called influence on people's affairs. 2. A Greek astronomer who first figured the circumference of the earth in 250 B.C. 3. the invention of the telescope by Lippershay 4. A pentametre is a unit of measurement of one trillion kilometres. **III.** 1-b, 2-b, 3-b, 4-c **IV.** 1. False. Astronomers can predict eclipses. 2. False. We can use an instrument called a thermocouple. 3. False. It is a measure of distance. 4. False. It can be studied during the day, too. **V.** 1. ½ circle = 180° 2. 300 000 km/s 3. 150 million km. 4 larger (384 000 km), 5. circumference **VI.** Have students report their results to the rest of the class. **VII.** No one has ever checked if all people have had old friends appear.

**UNIT II: Chapter 3**

**I.** 2, 4 **II.** 1-1, 2-2, 3-4, 4-5 **III.** 1-d, 2-b, 3-b, 4-a **IV.** 1. biologist 2. projector 3. mirror or lens **V.** 1. False. They work together. 2. False. Radio telescopes do not have lenses. 3. True. Gravitation is the attraction among all bodies in the universe, whereas gravity is the attraction between the earth and the bodies on it. 4. True. The astronauts are checked at all times. **VI.** Have students report to the rest of the class. **VII.** Have students report to the rest of the class.

**Chapter 4**

**I.** 1, 4 **II.** 1-7, 2-6, 3-3, 4-4 **III.** 1-d, 2-b, 3-a, 4-d **IV.** 1. reflector dish 2. reflector, antenna 3. receiver 4. to gather light and bring it to a focus and also to enlarge an image 5. with a larger objective lens or mirror **V.** 1. They are invisible to the human eye. 2. It is the visible part of the spectrum which is white light, a combination of all the colors (ROYGBIV). 3. A photometer measures the intensity of light. A spectroscope analyzes light. 4. It can be used to measure angles that heavenly bodies make with the horizon. **VI.** Have students demonstrate their results to the rest of the class. **VII.** Report these lists to the class. **VIII.** Report these lists to the class.

**Chapter 5**

**I.** 1, 2 **II.** 1. Constellations 2. Jupiter, Saturn, Venus, Mars, Mercury 3. It is a large system of stars, dusts, gases and all their attendant bodies. 4. The attractive interaction of astronomical bodies keep these bodies in elliptical orbits. **III.** 1-a, 2-d, 3-b, 4-b **IV.** 1. Venus is a planet; all the others are stars. 2. Moon is a satellite; all the others are planets. 3. Asteroids or planetoids are tiny planets; all the others are star system. 4. Eclipse is the darkening of one body by another; all the others are motions. **V.** 1. True 2. True 3. False. New bodies are constantly being formed. 4. True

**VI.** 1. ELL$\overset{2}{\text{I}}$PSE, 2. GAL$\overset{5}{\text{A}}$$\overset{10}{\text{X}}$Y, 3. $\overset{3}{\text{C}}$$\overset{11}{\text{O}}$$\overset{8}{\text{N}}$STELLATIO$\overset{12}{\text{N}}$, 4. O$\overset{1}{\text{R}}$B$\overset{9}{\text{I}}$T, 5. BRA$\overset{4}{\text{H}}$E, 6. ASTE$\overset{6}{\text{R}}$OI$\overset{7}{\text{D}}$–$\overset{1}{\text{R}}\overset{2}{\text{I}}\overset{3}{\text{C}}\overset{4}{\text{H}}\overset{5}{\text{A}}\overset{6}{\text{R}}\overset{7}{\text{D}}$ $\overset{8}{\text{N}}\overset{9}{\text{I}}\overset{10}{\text{X}}\overset{11}{\text{O}}\overset{12}{\text{N}}$

**Chapter 6**

**I.** 2, 3 **II.** 1-1, 2-9, 3-11, 4-4 **III.** 1-b, 2-c, 3-c, 4-b **IV.** 1. Mars 2. Mercury 3. Mars 4. Saturn 5. Jupiter 6. Venus 7. Mars 8. Mars 9. Mars 10. Mercury, Venus, or Pluto **V.** 1. False. Unmanned satellites have radioed pictures back to earth that show these markings to be natural. 2. False. These are meteors that burst into flame when they enter the earth's atmosphere. 3. False. The great Red Spot is a marking found on the atmosphere of the planet Jupiter 4. True. **VI.** Read the best story to the class. **VII.** Have students show their scrapbooks to the rest of the class.

**Chapter 7**

**I.** 2,3 **II.** 1-2, 2-3, 3-5, 4-7 **III.** 1-b, 2-d, 3-b, 4-a **IV.** Answers will vary. **V.** Have students report to the rest of the class. **VI.** Have students report to the rest of the class. **VII.** 1-g, 2-e, 3-h, 4-d, 5-c, 6-f, 7-j, 8-i

**Chapter 8**

**I.** 2, 4 **II.** 1. one–two billionth of the sun's energy 2. Visible light helps produce energy for photosynthesis for growth of plants. Animals eat the plants. Fossil plants and animals formed crude oil. Crude oil is made into gasoline. 3. nuclear fusion 4. in the core of the sun **III.** 1-d, 2-b, 3-b, 4-d **IV.** 1. photosphere 2. the core of the sun 3. radiant 4. fossil coal 5. the sun **V.** 1. time it takes for light to get to the earth from the sun 2. the speed of light in kilometres per second 3. the average distance in kilometres of the earth from the sun 4. the diameter of the earth in kilometres 5. the circumference of the earth in kilometres 6. the sunspot cycle in years 7. the temperature of the core of the sun in °C 8. year of high sunspot activity **VI.** Have students report to the rest of the class.

### Chapter 9

**I.** 2, 3 **II.** 1-5, 2-3, 3-6, 4-7 **III.** 1-b, 2-d, 3-d, 4-d **IV.** 1-b, 2-a, 3-g, 4-f, 5-d, 6-h, 7-j, 8-e **V.** Have students report to the rest of the class. **VI.** Cut out a square about 15 cm x 15 cm. Hold this at arms length and count the number of stars seen in this square. Then estimate the number of squares it would take to cover the sky and multiply that by the star count. **VII.** Have students show their projects to the rest of the class.

### UNIT III: Chapter 10

**I.** 1, 3 **II.** 1-3, 2-1, 3-5, 4-6 **III.** 1-a, 2-b, 3-b, 4-b **IV.** 1. 12 800 km, 2. 22/8, 3. angles, 4. horizon, 5. shadows

**V.** 1. $C = \pi D$ = 22/7 x 3480 = 10 940 km

2. $C = \pi D$ = 22/7 x 6759 = 21 245 km

**VI.** Have students read their reports to the rest of the class. **VII.** Place on bulletin board.

### Chapter 11

**I.** 2, 4 **II.** 1-3, 2-5, 3-7, 4-7 **III.** 1-a, 2-c, 3-b, 4-d **IV.** 1. sphere 2. 9, 3. reflects 4. orbit 5. rotates 6. axis 7. west 8. east 9. 1700 (at the equator), 10. pendulum **V.** 1. BRAHE, 2. GALILEO, 3. FAUCAULT, 4. NEWTON, 5. PTOLEMY, 6. KEPLER, 7. ERATOSTHENES–BEATLES **VI.** 1. the rotating earth 2. rotation 3. always in the same back and forth motion **VII.** 1. Rotation is spinning on an axis. Revolution is movement around another body in an orbit. 2. Atmosphere is the air surrounding the earth. Chronosphere is part of the atmosphere of the sun which gives it its color. 3. Circle is a two-dimensioned body. Sphere is a three-dimensional body. Both are round. 4. Sunset is the time of day when due to the rotation of the earth the sun disappears from view. Sunspots are magnetic storms on the sun. 5. Crude oil is the fossil fuel pumped from the earth. Petroleum is the refined crude oil.

### Chapter 12

**I.** 1, 3 **II.** 1. Galilei Galileo 2. Yes! On July 20, 1969 for the first time 3. The moon is smaller than the earth and its gravity is 1/6 of that of the earth. 4. The escape velocity from the moon is small enough to allow water and air molecules to escape from the moon. **III.** 1-a, 2-c, 3-a **IV.** 1. True. Pumice is a volcanic rock. 2. True. Landing on the moon proved this. 3. True. The gravitational pull of the moon is 1/6 that of the earth. **V.** 1. 50, 2. ¼, 3. the distance from the moon to the earth, 4. the distance in kilometres from the earth to the sun, 5. 1, 6. 9. (Note: Answers given in text for 3 and 4 are incorrect. Correct answers are: 3. 384 000 km 4. 149 600 km)

### Chapter 13

**I.** 1, 2 **II.** 1-4, 2-6, 3-3, 4-4 **III.** 1-b, 2-a, 3-c, 4-b **IV.** 1. True. We see the moon by reflected light from the sun. 2. True. The light from the sun is reflected from the earth. 3. False. We can see the moon by light reflected from the earth to the moon and back to the earth. **V.** 1. later 2. new moon to new moon 3. like 4. 7% **VI.** Have students show their results to the rest of the class. **VII.** Have students report their results to the rest of the class. **VIII.** Crescent–bow shaped, terminating in points. Gibbous–humpbacked.

### Chapter 14

**I.** 2, 4 **II.** 1-5, 2-3, 3-2, 4-5 **III.** 1-b, 2-c, 3-a, 4-b **IV.** 1-a, 2-j, 3-c, 4-b, 5-i, 6-h, 7-g, 8-d **V.** 1. SPHERE, B. TIDE, 3. PHASE, 4. CRESCENT, 5. ORBIT–PIANO **VI.** Post on bulletin board. **VII.** Ask any French-speaking or Spanish-speaking students in the class to give the correct pronunciations of these words.

### Chapter 15

**I.** 2, 4 **II.** 1. the shape of the opaque object blocking the light 2. conical (cone shaped) shadows 3. Full moon phase. The shadow of the earth falls on the moon. 4. a lunar eclipse **III.** 1-a, 2-b, 3-c, 4-c **IV.** 1. True. The longest time for a solar is 7½ minutes whereas a lunar eclipse lasts as long as 2 hours. 2. False. The eclipse travels eastward. 3. False. Eclipses occur only when the sun, moon, and earth are in a direct line. 4. False. Never look directly at the sun with the naked eye. **V.** Have students report to the rest of the class. **VI.** Have students read their reports to the rest of the class. **VII.** Have students report their findings to the class.

### Chapter 16

**I.** 1, 4 **II.** 1-6, 2-5, 3-4, 4-4 **III.** 1-b, 2-c, 3-a, 4-c **IV.** 1. False. A star is more correct. 2. True. Its time intervals were invented. They have nothing to do with astronomy. 3. False. Any time from 18 hours on is usually night time. **V.** 1. moon 2. opaque 3. new moon 4. 3000 km, 5. 1/6 **VI.** Post on bulletin board. **VII.** Have students report to the rest of the class. If possible, have photos made of the sundial.

**Chapter 17**

**I.** 3, 4 **II.** 1-4, 2-4, 3-5, 4-6 **III.** 1-c, 2-a, 3-a, 4-c **IV.** 1-g, 2-e, 3-h, 4-f, 5-d, 6-c **V.** 1. Yes. The light would now reach the west first. 2. This was done to set up a point of reference. 3. Not too well. Its light would spread too much. **VI.** 1. because of the relative positions of earth, moon and sun 2. March 6 and 7, 1962. 3. Perigee—point of the moon's orbit nearest the earth. Syzygy—point where moon and sun are in opposition or conjunction. 4. because of prior learning

**Chapter 18**

**I.** 1, 2 **II.** 1. The inclination of the earth's axis with respect to the sun and the revolution of the earth around the sun changes with the seasons. 2. The direct rays are more concentrated and therefore produce more heat. 3. December 4. It is the calendar set up by Pope Gregory to correct the Julian Calendar. **III.** 1-b, 2-a, 3-a, 4-c **IV.** 1. It absorbs most of the light and heat. 2. Light falling at a slant covers a wide area. 3. The equator has vertical rays at both equinoxes (usually March 21 and September 23). Fig. 135-1 1. Diagram 4, 2. Diagram 2. **V.** 1. No. It has to be a number that can be divided by 4. 2. No. Less than ½ because it includes February which is a short month. 3. It occurs twice–at the equinoxes, March 21 and September 23, when it is equal day and night all over the earth. 4. Any place N of 66½° or S of 66½°S latitude. There are 24 hours of sunlight in the summer months. 5. He was born under the Julian Calendar and when the Gregorian Calendar was set up 11 days were added to make the date February 22. **VI.** 1. a.m. = ante meridian–before the shortest shadow cast by the sun (noon). p.m. = post meridian–after the noon shadow. 2. A.D. means "anno domini"–*in the year of the Lord* as our dates are measured since Christ. B.C. means "before Christ." 3. The date March 21, when the vertical rays of the sun are over the equator. 4. The date June 21, when the vertical rays of the sun are over the Tropic of Cancer.

**UNIT IV: Chapter 19**

**I.** 1, 4 **II.** 1-1, 2-4, 3-5, 4-7 **III.** 1-d, 2-b, 3-b, 4-a **IV.** 1. True. For example, when a LM lands on the moon, it has a rocket system which enables the LM to take off from the moon. The rocket remains behind. 2. False. It has peaceful scientific trends, too. **V.** 1. one who flies in and directs the path of a space capsule 2. a device for getting a payload into space 3. the rocket which gets the payload into space 4. the actual capsule of a space probe 5. the place where spacecrafts dock with one another **VI.** Have students read their reports to the rest of the class. **VII.** Post these on the bulletin board.

**Chapter 20**

**I.** 1, 2 **II.** 1-5, 2-7, 3-8, 4-4 **III.** 1-a, 2-b, 3-b, 4-c **IV.** 1. False. They are picked mostly for their intelligence and reaction-time. 2. True. 3. False. He can wear a support system or be supplied by umbilical cords. **V.** 1. As they are in a "weightless" condition, the food has to be squeezed into their mouths or it would float away. 2. In order to lessen the effect of "g" forces 3. It has to supply all the heat, pressure and air needed by the astronaut. 4. They are absorbed by the ozone layer of the earth's atmosphere. **VI.** 1-j, 2-f, 3-i, 4-d, 5-c, 6-h, 7-e, 8-b

**Chapter 21**

**I.** 3, 4 **II.** 1. Thrust = To push forcibly. This is the force which pushes the rocket into space. 2. There is a lack of oxygen in space. Spark plugs need oxygen to support the spark. 3. Parts can be abandoned as their function is finished. 4. The payload is lightened. **III.** 1-a, 2-d, 3-a **IV.** 1. True. A pound is a unit of force. 2. False. It usually is the strongest as it has to move the spaceship from the earth. 3. False. It has to be so designed that it will be able to escape from the earth's surface. **V.** 1. Van Allen 2. orbit 3. liquid hydrogen 4. Liberty 5. cosmic rays **VI.** 1. The balloon will move in the opposite direction from the escaping steam. 2. The fuller it is blown up the faster it will move when the air is let out.

**Chapter 22**

**I.** 1, 4 **II.** 1-3, 2-2, 3-6, 4-5 **III.** 1-d, 2-b, 3-a, 4-b **IV.** 1. velocity necessary for orbiting the earth 2. velocity necessary for escaping from the earth 3. the height at which the parachutes of the returning capsule open 4. countdown **V.** 1. The first stage of the rocket which gets the spaceship up to the required height. 2. The curve is the resultant motion between the inertia and gravitation. 3. Where the atmosphere is closest to the earth's surface.

Here the atmosphere is most dense. **VI.** 1. ROCKET 2. LAUNCH 3. APOLLO 4. BOOSTER–ENOS **VII.** Post on bulletin board.

**Chapter 23**

**I.** 2, 4 **II.** 1-1, 2-3, 3-4, 4-5 **III.** 1-a, 2-b, 3-b, 4-a **IV.** 1. False. The Vostok I crewmen were the first. 2. True. 3. False. An unmanned space-probing satellite. **V.** 1. Tiros 2. moon taxi 3. Shephard, 4. escape velocity, 5. Mariner 9 **VI.** Have students read their stories to the rest of the class. **VII.** Have students show these photographs to the rest of the class.

# CHEMISTRY 3—CHEMISTRY OF METALS

**UNIT I: Chapter 1**

**I.** 1, 2 **II.** 1-8, 2-4, 3-6, 4-11 **III.** 1-b, 2-c, 3-d, 4-b **IV.** Have students report these changes to the rest of class. **V.** 1. A proton is a positive charge of electricity located in the nucleus of an atom. An electron is a negative charge of electricity located outside of the nucleus. 2. A physical change is one that changes the size, shape, color, or phase of matter. A chemical change produces a new substance. 3. An element is the simplest form of a substance. A compound is a chemical combination of two or more elements in definite proportions. 4. The Bohr Atom is a description of an atom in which the electrons follow definite paths around the nucleus like the planets in the solar system. The Electron Cloud Theory states that the electrons move around the nucleus so fast and in so many directions that they seem to enclose the nucleus in a cloud. 5. A chemical family is a vertical row of elements on the Periodic Table. The elements have similar chemical characteristics. There are 18 families. A chemical period is a horizontal row of elements on the Periodic Table. There are 7 periods.

**VI.** 1. organic chemistry 2. organic chemistry 3. organic chemistry 4. inorganic chemistry 5. organic chemistry 6. organic chemistry

**VII.** 1. a-chemical, b-electricity, c-Water contains two hydrogen atoms for every oxygen atom. 2. a-No new substance is formed. b-to condense the water vapor, c-The boiling water evaporates from the beaker and condenses on the glass plate.

**Chapter 2**

**I.** 1, 3 **II.** 1-5, 2-7, 3-8, 4-4 **III.** 1-b, 2-c, 3-a, 4-b, 5-c **IV.** 1. gold 2. iron (1535°C) 3. potassium 4. magnesium 5. atomic mass

$$\textbf{V.}\ 1.\ 12 \times 1000\ \text{kg} = \frac{12\ 000\ \text{kg}}{3\ \text{truckloads}} = \frac{4\ 000\ \text{kg}}{\text{truckload}}$$

2. 11 m = 11 x 1000 cm = 11 000 cm

3. Specific gravity (Al) = 2.70
   2.70 × 3 = Specific gravity (X)
   8.10 = Specific gravity (X)
   Specific gravity (Fe) = 7.86

The mass of three bricks of aluminum is approximately equal to the mass of one brick of iron. **VI.** 1. g 2. a 3. j 4. e 5. h 6. f 7. d 8. i

**UNIT II: Chapter 3**

**I.** 1, 2 **II.** 1. Tensile strength makes metals useful as cables for derricks, elevators and bridges. 2. The magnetic metals are iron, nickel and cobalt. 3. The flame color is used to identify the metal. 4. Radioactivity can be measured by an instrument called a Geiger counter. **III.** 1-b, 2-d, 3-b, 4-c, 5-c **IV.** 1. Ductile refers to the ability of a metal to be drawn into fine wires. Tensile refers to the ability of a metal to keep from being pulled apart. 2. A conductor is a metal which allows heat and electricity to pass through it easily. An insulator is a material which does not allow heat and electricity to pass through it easily. 3. Density is the mass per unit volume of a substance. Mass is the amount of matter a substance has. 4. A rod of steel is composed of many strands. A strand of steel is a very thin wire of steel. 5. Magnetite is iron oxide, a natural magnet. A magnet is any substance made of iron, nickel, or cobalt which has magnetic properties.

**V.** 1. hydrogen 2. chlorine 3. pitchblende 4. carbon dioxide and oxygen (non-metals)

**VI.** Have students read these reports to the rest of the class. **VII.** The match which burns first is attached to the best conductor of heat.

**Chapter 4**

**I.** 1, 4 **II.** 1-1, 2-4, 3-5, 4-8 **III.** 1-c, 2-b, 3-a, 4-c, 5-a **IV.** 1. LEFT 2. True 3. True 4. GASES 5. ONE **V.** 1. They can easily be cut with a knife. This should be demonstrated only by the teacher. 2. The heat generated by the reaction between the potassium and water is great enough to ignite the freed hydrogen gas. **VI.** 1. h elium 2. o rbit 3. c alcium 4. k rypton 5. e lement 6. y ttrium–HOCKEY **VII.**

**Chapter 5**

**I.** 1, 2 **II.** 1-4, 2-2, 3-3, 4-4 **III.** 1-c, 2-d, 3-a, 4-c **IV.** 1. True. a–the elements of the substance, b–how many atoms of each element are in a molecule of the substance. 2. False. $H_2$ tells you that a molecule of hydrogen has two atoms. 3. False. A subscript is written after the symbol for an element. 4. True. Formulas can be read as names. **V.** 1. chemical 2. solution 3. metals 4. Roentgen 5. Geiger counter 6. nickel 7. family or group 8. volume **VI.** 1. a. Fe, Ni, Co, Au, Ag. b. sodium, platinum, potassium, copper, zinc 2. silver iodide, sodium chloride, glucose (sugar), sulfuric acid, silicon dioxide (sand) **VII.** Have students report to the rest of the class on their findings.

### Chapter 6

**I.** 1, 3 **II.** 1. This is the mass of the compound. 2. Figure out the percentage by mass of the elements in the compound. 3. Refer to the element in the Periodic Table. 4. Find the atomic masses of the elements first; $H = 1$, $O = 16$. Formula for water is $H_2O$; $(1 \times 2) + (16) = 18$, the formula mass for water. **III.** 1-a, 2-b, 3-a
**IV.** 1. It tells how many atoms of hydrogen are in a water molecule. 2. 22.9(Na) + 35.5(Cl) = 58.4 (NaCl molecular mass) 3. 3 calcium, carbon, and oxygen 4. C (carbon) **V.** 1-f, 2-a, 3-b, 4-i, 5-d, 6-e, 7-h, 8-g

### Chapter 7

**I.** 1, 2 **II.** 1-5, 2-1, 3-1, 4-5 **III.** 1-c, 2-b, 3-b, 4-d
**IV.** 1. True. The magnesium atom has 2 electrons to lend and the oxygen atom borrows both. 2. False. They lend only from the outermost shell. 3. True. They borrow to complete their outermost shells. 4. False. It is governed by the number of electrons in the outermost shell.
**V.** 1. A proton is a positive charge of electricity. An electron is a negative charge of electricity. 2. The nucleus is the central part of an atom containing protons and neutrons. An energy shell is an orbit around the nucleus in which electrons are found. 3. A metal is an element which loans electrons. A nonmetal is an element which borrows electrons. 4. A chemical borrower is a nonmetal. A chemical lender is a metal. **VI.** *Across* 1. Krypton 2. neutron 5. inert *Down* 2. Ni 3. proton 4. neon.

### Chapter 8

**I.** 2, 3 **II.** 1-1, 2-3 (see table p. 59), 3-2, 4-4
**III.** 1-a, 2-b, 3-b, 4-c **IV.** 1-j, 2-a, 3-i, 4-c, 5-d, 6-h, 7-e, 8-g **V.** 1. orbits 2. 2 3. 2 4. 100 5. ores 6. protons 7. 103 8. atomic

### UNIT III: Chapter 9

**I.** 2, 4 **II.** 1. Rust forms by the oxidation of iron to form iron oxide. 2. The compound reverts back to the elements that composed it. 3. He showed how a compound is formed from its elements. 4. Two elements combine to form a compound. **III.** 1-c, 2-c, 3-b, 4-b **IV.** 1. Slow oxidation is the chemical combination of a substance with oxygen with no noticeable light or heat given off. Burning is rapid oxidation with light and heat given off. 2. A sulfide is a compound of a metal element and sulfur. An oxide is a compound of a metal element and oxygen. 3. A combination is the joining of two or more elements to form a compound. Decomposition is the breaking up of a compound into its elements. 4. Mercury is an element. Mercuric oxide is a compound of mercury and oxygen. **V.** 1. to take the place of the used–up oxygen 2. mercuric oxide 3. combination 4. When the dime (Ag) combined with sulfur (S), it tarnished. 5. The black compound is silver sulfide ($Ag_2S$).
**VI.** 1. False. Rusting is a slow oxidation process. 2. True. $2Hg + O_2 \rightarrow 2HgO$. Mercury is in the liquid state at room temperatures. Oxygen is a gas. 3. False. Light and electric energy can cause chemical reactions, too. 4. True. This is a decomposition experiment. Lavoisier did a combination experiment. **VII.** The coin exposed to the air will tarnish. It has combined with the sulfur in the air.

### Chapter 10

**I.** 1, 3 **II.** 1-4, 2-2, 3-4, 4-3 **III.** 1-c, 2-b, 3-d, 4-a
**IV.** 1. This tube allows a small amount of acid at one time to come directly into contact with the zinc. 2. You could use a funnel. 3. Pour some water over the zinc then add the concentrated acid. 4. Aluminum would give the same results because both zinc and aluminum are more active than hydrogen. **V.** 1-e, 2-a, 3-j, 4-g, 5-b, 6-c, 7-d, 8-h **VI.** 1. $NaHCO_3$ = sodium bicarbonate
2. $H \cdot C_2H_3O_2$ = acetic acid (vinegar) 3. Bubbles of $CO_2$ gas will begin to form very rapidly.
4. The sodium is released from the carbonate and combines with the acetate radical to form sodium acetate. The H of the acid combines with the $HCO_3$ to form $H_2CO_3$ (carbonic acid) which decomposes to form water and $CO_2$ gas.
5. $NaHCO_3 + H \cdot C_2H_3O_2 \rightarrow NaC_2H_3O_2 + H_2O + CO_2 \uparrow$

### Chapter 11

**I.** 1, 3 **II.** 1-6, 2-7, 3-5, 4-7 **III.** 1-d, 2-b, 3-b, 4-d
**IV.** 1. Electromotive Series 2. more active 3. hydrogen 4. an acid 5. energy shells 6. valence 7. less active **V.** 1. True. The lower the valence, the more active the substance is. Sodium has a valence of +1. Magnesium has a valence of +2. 2. False. 3. False. Gold is less active than potassium. **VI.** Have students read the science safety rules before attempting these experiments.
**VII.** Post these charts on the bulletin board.

### Chapter 12

**I.** 2, 4 **II.** 1. In ordinary chemical changes, matter can neither be created nor destroyed.

2. $\dfrac{24\ (\text{Mg})}{40\ (\text{Total})} \times 100 = 60\%$ Mg to 40% $O_2$.

Therefore one needs 60 kg of Mg to make 100 kg of MgO. 3. The end product will also be 228 because of the Law of Conservation of Matter. 4. One can figure out beforehand how much of each chemical one has to add to the manufactured chemical product. **III.** 1-b, 2-d, 3-a, 4-b **IV.** 1. chemical change 2. sodium nitrate 3. We do this so that we can balance the test tubes in the beaker and determine their weights. 4. The pointer remains in the center at the zero mark. 5. We would have to add more weights.

**V.** 1. $$\overset{X}{2Mg} + O_2 \rightarrow \overset{34\text{ kg}}{2\text{ MgO}}$$

$$2 \times 24 \text{ atomic mass}$$

$$2(24 + 16) \text{ formula mass}$$

2. $$\frac{X}{48} = \frac{34}{80}$$

3. $$X = \frac{34 \times 48}{80} = 20.4 \text{ kg}$$

4. or $.60 \times 34 = 20.4$ kg Mg

**VI.** 1. True. Oxygen in the air is free. 2. True. It really is the Law of Conservation of Matter and Energy that applies. 3. True. They tell how heavy an element is in relation to an equal volume of carbon 12. **VII.** eNergy, cAlcium, graM, vAlence, Tin, Helium–NAMATH

### Chapter 13

**I.** 2, 3 **II.** 1-5, 2-3, 3-5, 4-2 **III.** 1-b, 2-b, 3-d, 4-a **IV.** 1. Vacuum bottles are used so that the heat produced can be retained. 2. It is called a control. 3. We should always use a Celsius thermometer. 4. The heat produced is not great enough to reach the kindling temperature of the steel wool. 5. We use corks to conserve the heat. 6. The heat comes from the energy produced by the oxidation of the steel wool. **V.** 1. $2C - 0_2$ $2CO$ 2. $Ca + O_2 \rightarrow 2CaO$ 3. Balanced. **VI.** 1. Becquerel first studied the radiation resembling X-rays. 2. Curie discovered the new elements polonium and radium. 3. Cavendish discovered hydrogen gas. 4. Lavoisier stated the Law of Conservation of Matter. **VII.** 1. $NaCl$, $CO$, $MgSO_4$, $NaHCO_3$, $I_2$, $C_6H_{12}O_6$ 2. iron, tin, mercury, calcium, radium, gold, silver

### Chapter 14

**I.** 3, 4 **II.** 1-3, 2-1 and 4, 3-4, 4-7 **III.** 1-c, 2-a, 3-b or d, 4-a **IV.** 1. DRY 2. OIL 3. SULFIDE 4. PAINT 5. OXIDE **V.** 1. Steel wool contains the element iron. 2. Make precise measurements. 3. No. The burning steel wool will still use up 1/5 of the air, or all the oxygen present. 4. It proves the Law of Conservation of Matter. The oxygen gas in the air is now part of the iron oxide compound. **VI.** Have students show samples to the rest of the class. **VII.** 1. chemical–metal decay 2. air pollution 3. sulfur and salt water 4. Apply a coat of wax or use fans to drive away pollutants. 5. an alloy of copper 6. Yes, it is not autos.

### Chapter 15

**I.** 1, 4 **II.** 1. A solution which can conduct electricity 2. Galvanizing is plating iron with zinc; tinning is plating iron with tin. 3. Free metallic ions are attracted to the cathode (–) where they pick up electrons and become metallic atoms and are deposited. 4. Chromium is used to plate car bumpers, pots and vases. **III.** 1-b, 2-c, 3-c, 4-d **IV.** 1. In electroplating, an object is plated by electricity. In thermoplating, iron is dipped into warm baths of melted zinc or tin. 2. An anode is a positive electrode. A cathode is a negative electrode. 3. Corrosion is a chemical process in which a metal combines with another substance and loses its metallic properties. Decomposition is a chemical process in which a compound is broken down into its elements. 4. Slow oxidation produces no noticeable light or heat. Burning is rapid oxidation with light and heat given off. 5. Neutralization is the combination of an acid and a base to form a salt and water. Combustion is burning or rapid oxidation. **V.** 1. We close the switch to allow the flow of electricity. 2. The cathode is made of the metal to be plated. The anode is made of the plating metal in this case, copper. 3. They become copper. 4. They go to the cathode where they pick up electrons and become copper atoms. Opposite charges attract.

### UNIT IV: Chapter 16

**I.** 1, 2 **II.** 1-8, 2-8, 3-6, 4-11 **III.** 1-b, 2-c, 3-a, 4-b **IV.** 1. A sulfide is a compound containing sulfur. A carbonate is a compound containing the carbonate radical. 2. A mineral is an inorganic substance of definite composition. An ore is a mineral that contains metals. 3. Prospecting is the search for precious metals or ores. Mining is the process of getting ores from the earth. 4. Smelting is the process of obtaining a metal from its ore by heat. Electrolysis is the process of separating elements from a compound by an electric current. **V.** 1-28, 2-47, 3-3, 4-6 **VI.** 1. They were already in their pure state. 2. One does not need elevators, deep pits, and passageways in open-pit mining. 3. Nickel is a more valuable metal. 4. It destroys forests and wildlife disappears.

**VII.** 1. $A1_20_3$ - Aluminum Oxide 2. Pbs - Lead Sulfide 3. $Fe3_20_3$ - Ferric Oxide 4. $MgBr_2$ -Magnesium Bromide **VIII.** Post on the bulletin board.

**Chapter 17**

**I.** 2, 4 **II.** 1. The ore is melted with high heat in a special container. The positive $Mg^{++}$ ions move to the cathode where it gains electrons and becomes Mg atoms. 2. aluminum 3. Sulfide ores are first roasted to form an oxide of the metal and then they are reduced by carbon. 4. By the reduction process using carbon **III.** 1-a, 2-d, 3-a, 4-c **IV.** 1. False. It uses 2 steps: roasting and reduction. 2. True. The metal in an oxide is replaced by carbon, producing carbon dioxide and the free metal. 3. False. It drives off sulfur. 4. True. Magnesium and chlorine are formed. **V.** 1. self-explanatory 2. aluminum ladder is lighter than wood 3. a. U.S.A., b. varies year to year, c. Arkansas, Georgia, Alabama **VI.** 1-f, 2-a, 3-b, 4-c, 5-d, 6-e, 7-j

**Chapter 18**

**I.** 2, 3 **II.** 1-7, 2-3, 3-3, 4-4 **III.** 1-d, 2-a, 3-b, 4-c **IV.** 1. iron ore, coke and limestone 2. slag and pig iron 3. molten pig iron 4. molten cast iron, scrap steel, limestone, and hematite **V.** 1. Pig iron is iron which contains a great deal of carbon. Cast iron is pig iron cast into molds. 2. Iron is a metallic element. Steel is iron with very small amounts of carbon in it. 3. Open hearth is a steelmaking process which uses heat over the roof of the furnace. The Bessemer converter is a method for changing pig iron into steel by blasting air through the molten iron. 4. Rolling is the process by which metals are rolled into sheets. Casting is the process by which cast iron is poured into molds. **VI.** 1. Chicago, Ohio and Pittsburgh 2. changes yearly. 3 changes each year **VII.** 1-k, 2-f, 3-c, 4-i, 5-b. 6-d, 7-g, 8 e

**Chapter 19**

**I.** 1, 2 **II.** 1-8, 2-2, 3-4, 4-6 **III.** 1-d, 2-b, 3-a, 4-d, 5-c **IV.** 1. True. This gives it its color. 2. False. They are mixtures of metals. 3. False. Red lead is lead oxide. White lead is lead carbonate. 4. True. Aluminum is less dense than iron. **V.** magnets–alnico; cheap knives and forks–stainless steel; toasters–nichrome; electrical connections–solder; church bells–brass **VI.** 1. pitchblende 2. radioactive 3. half-life 1600 4. cyclotron 5. energy **VII.** 1. solid pigment, liquid oil, thinner, and dryer 2. Neils Bohr described the atom as being like a small solar system.

**Chapter 20**

**I.** 3, 4 **II.** 1. A penny is an alloy of 95% Cu and 5% Zn. 2. Polishing will remove the sulfide from the silver. 3. Gold is found as a free or native metal. 4. Gold in bars is called bullion. **III.** 1-d, 2-b, 3-a, 4-d, 5-a **IV.** 1. 58%, 2. 92%, 3. non-silver clad quarters 4. 197, 5. 47 **V.** 1. The enamel does not enter into the reaction whereas the aluminum pan would. 2. Electrolysis is taking place. 3. It deposits on the aluminum. 4. It makes the water a conductor of electricity. **VI.** 1. pig iron 2. iron or chromium 3. An amalgam has mercury. An alloy is a mixture of metals. 4. Electromotive Series **VII.** 1. These costs change year to year. 2. Have students report on what they see.

**Chapter 21**

**I.** 1, 4 **II.** 1-1, 2-5, 3-4, 4-2 **III.** 1-c, 2-a, 3-c, 4-a, 5-c **IV.** 1-f, 2-a, 3-j, 4-d, 5-b, 6-i, 7-g, 8-h **V.** 1. 4 2. ions 3. calcium 4. sodium 5. solutions

**VI.** Post these lists on the bulletin board.

**VII.** Post one of these graphs on the bulletin board.

**Chapter 22**

**I.** 1, 4 **II.** 1-5, 2-5, 3-8, 4-7 **III.** 1-b, 2-b, 3-a, 4-b, 5-d **IV.** Exposing the film. Developing the film. Fixing the film. Exposing the negative. Developing the print. Fixing the print. **V.** 1. Developing brings out the image on the exposed silver salts. Printing produces a positive from the negative. 2. Developer is the chemical that brings out the image. Fixer is the chemical that stops the developing process. 3. Contact printing is the process by which a print is made the same size as the negative. Enlargement printing is the process by which a print is made larger than the negative. 4. Blueprint paper is coated with iron salts which turn blue in light. Photographic paper is silver bromide or silver iodide which turns black on exposure to light. **VI.** 1. Light turns the paper blue. 2. The silver-salts coating turns black in light. 3. The film has not been exposed to light. 4. The chemicals which are untouched by light must first be washed out before an image can be seen on the paper.

**Chapter 23**

**I.** 2, 4 **II.** 1. Tin cans are steel containers covered with tin. 2. Cows that graze on grass that contains $^{90}Sr$ will produce milk with $^{90}Sr$ in it. 3. Now no lead will be shot out into the air. 4. To prevent babies from chewing the painted wood. **III.** 1. calcium 2. killers of rats 3. (Note: This answer not shown in text. Text should read plastics manufacture or aluminum recycling). 4. Radio-active material breaks down by half.

# PHYSICS 3—SOUND AND LIGHT

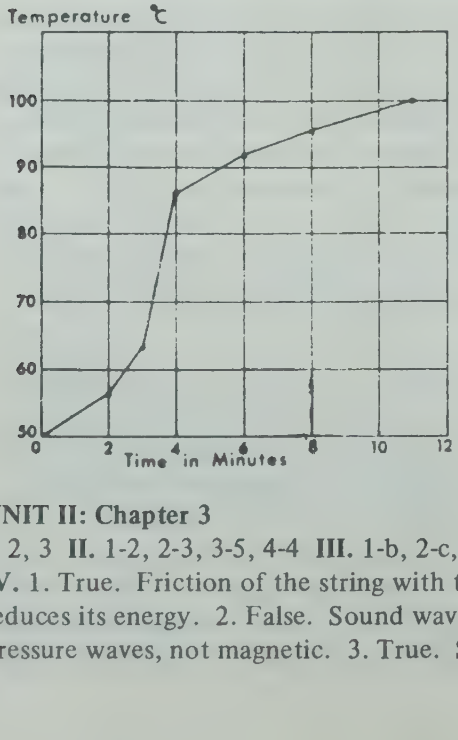
**UNIT I: Chapter 1**

**I.** 2, 4 **II.** 1-7, 2-1, 3-3, 4-5 **III.** 1-b, 2-b, 3-c, 4-b **IV.** 1. True. Matter is anything which has weight and occupies space. 2. True. When a liquid changes to a gas (evaporates), the added heat energy causes the molecules to move further apart. 3. False. A machine only changes the form of energy. 4. False. Molecules may consist of one, two or more atoms. **V.** 1. *Photosynthesis* is the process by which a green plant uses the *radiant energy* of the sun to produce its food. 2. *Petroleum* is a liquid fuel which was produced by fossil fish. 3. *Volume* is the amount of *space* that matter occupies. 4. The law of the *conservation* of *energy* states that energy can neither be created nor destroyed. **VI.** 1. degrees 2. matter 3. heat 4. 100°C

**Chapter 2**

**I.** 1, 3 **II.** 1. Sound and light are measured in units called linear or distance measurements, time, volume and temperature. 2. Sound is used for communication, enjoyment and work. 3. Sound travels faster through ocean water than fresh water because of the greater density of salt water. 4. It translates sound into a visible wave form and makes it easier for scientists to study sound. **III.** 1-b, 2-b, 3-b, 4-b **IV.** 1-g, 2-d, 3-c, 4-e, 5-h, 6-i, 7-a **V.** 1. ruler 2. oscilloscope 3. thermometer 4. a lightmeter

**VI.**



**UNIT II: Chapter 3**

**I.** 2, 3 **II.** 1-2, 2-3, 3-5, 4-4 **III.** 1-b, 2-c, 3-a, 4-c **IV.** 1. True. Friction of the string with the air reduces its energy. 2. False. Sound waves are pressure waves, not magnetic. 3. True. Sound is the vibration of air and since air is colorless, we cannot see these vibrations. **V.** 1. 20, 2. 60, 3. 256, 4. $\frac{1}{2}$ **VI.** Note that the thinner wire will produce the higher pitch.

**Chapter 4**

**I.** 1, 3 **II.** 1. Carpets absorb sound waves. 2. The speed of sound in air is about 335 m/sec. 3. at least 16.75 m 4. solids **III.** 1-a, 2-a, 3-d, 4-b **IV.** 1. False. A tuning fork has a set pitch no matter with what it is hit. 2. False. Light travels much faster than sound. 3. False. They both have the same pitch but the quality of their sounds is different. **V.** 1. a bell jar 2. The motor operates the exhaust pump. 3. You begin to hear the bell ringing. Sound needs matter in order to be transmitted. Air is matter. 4. No. There is no atmosphere to transmit sound. **VI.** 1. molecules 2. energy 3. vibrate 4. radiant 5. photosynthesis

**Chapter 5**

**I.** 2, 3 **II.** 1-6, 2-7, 3-4, 4-2 **III.** 1-c, 2-a, 3-d, 4-a **IV.** 1-f, 2-c, 3-j, 4-h, 5-a, 6-d, 7-g, 8-b **V.** 1. Vibration 2. Iron 3. Echo 4. densiTy 5. eNergy 6. sonAr 7. vacuuM–VIETNAM **VI.** This is called a Dalton Whistle.

**Chapter 6**

**I.** 1, 4 **II.** 1-5, 2-5, 3-4, 4-4 **III.** 1-d, 2-d, 3-a, 4-a **IV.** 1. True. The raindrops splatter as they hit the ground and cause noise. The snowflake "floats" to the ground. 2. True. Because of reverberations between the mountains. 3. False. The pebble modulates the whistle vibrations, it does not cause them. 4. True. The greater the number of holes, the higher the pitch. **V.** 1-h, 2-b, 3-i, 4-e, 5-a, 6-c, 7-f **VI.** 1. Try to find out the material that makes up the bell, the pitch, and who manufactured it. 2. Try to get a picture of this bell. What caused the crack? 3. Try to get pictures to illustrate your report.

**Chapter 7**

**I.** 1, 4 **II.** 1-3, 2-6, 3-5, 4-6 **III.** 1-b, 2-c, 3-a, 4-d **IV.** 1. energy 2. pitch 3. vibrates 4. many sound sounds 5. air **V.** *Across* 1. pitch 2. loudness 3. sonar 4. vocal cords 5. vibrate *Down* 6. echo 7. ultrasonic 8. siren. **VI.** The stage directs sounds out to the audience. The stethoscope concentrates the sounds. Cupping your hands acts like a megaphone, making the sound waves move in one direction. The dog's ears perk up to catch the sounds better.

**Chapter 8**

**I.** 1, 4 **II.** 1. Musical beats are formed by the reinforcement of sound when two vibrating substances are "in step" with each other. 2. irregularly shaped curves as shown in Fig. 54-1 3. A fundamental tone is produced by a string which vibrates as a whole. This produces the lowest pitch. 4. An octave is represented by the 8 notes on the musical scale. **III.** 1-b, 2-a, 3-b, 4-a **IV.** 1. two 2. eight 3. 288 cps 4. an octave **V.** 1. fundamental 2. 288 cps 3. silence 4. octave 5. mi 6. an overtone **VI.** A tape recording can be made of this and replayed to the class.

**Chapter 9**

**I.** 1, 4 **II.** 1-5 and 6, 2-7, 3-4, 4-6 **III.** 1-b, 2-b, 3-a, 4-c **IV.** 1. cm. 2. atoms 3. 256 4. stops 5. 355 m/sec. **V.** 1. percussion 2. true 3. true 4. stop vibrating 5. longest **VI.** Suggest that the xylophones be played in class.

**Chapter 10**

**I.** 2, 4 **II.** 1-2, 2-8, 3-6, 4-7 **III.** 1-b, 2-a, 3-c, 4-d **IV.** 1. vibrate 2. They are pressed together and loosened. 3. at the same pitch as the voice 4. When the current flows through it. **V.** 1. The grooves cause the needle to vibrate. 2. There is nothing to amplify the sound. 3. The cone amplifies the sounds. 4. A megaphone. **VI.** 1. cycles per second 2. high fidelity 3. revolutions per minute 4. long-playing **VII.** The students' report may be read to the class.

**UNIT III: Chapter 11**

**I.** 1, 3 **II.** 1. This is sunlight reflected from the earth. 2. They are shaped by the object which blocks the light. 3. a material which gives off its own light; the sun, an incandescent lamp, a fire 4. Yes. It gives off its own light. **III.** 1-d, 2-a, 3-c, 4-b **IV.** 1. True. We see things by light reflected from them. 2. True. The aluminum is a better reflector of light. 3. True. This is called earthshine. 4. False. The size of the shadow can be larger or smaller than the object depending on the location of the source of light. **V.** 1. When the light source is overhead, the shadow is shorter than when the source is at a lower angle. 2. The shortest shadow cast that day. 3. Yes. It is opposite to the shadow direction at noon in the U.S. **VI.** Suggest that Polaroid pictures be taken of your results. Also put on a "shadow show" in the classroom.

**Chapter 12**

**I.** 1, 3 **II.** 1-6, 2-5, 3-5, 4-5 **III.** 1-c, 2-b, 3-a, 4-d **IV.** 1. The yardstick keeps the hose straight. 2. To line up the holes in the boxes. 3. It shows that light usually travels in a straight line. **V.** 1. True. Light can travel through a vacuum. 2. False. Light travels much faster than sound so we see the explosion before we hear it. 3. True. Light travels in straight lines. 4. False. It takes sunlight $8\frac{1}{3}$ minutes to reach our earth. **VI.** Show your results to the class. **VII.** 1. H.R. Hertz 2. the photon theory 3. to a positive plate

**Chapter 13**

**I.** 2, 4 **II.** 1-4, 2-5, 3-7, 4-6 **III.** 1-a, 2-b, 3-a, 4-b **IV.** 1-b, 2-e, 3-j, 4-a, 5-d, 6-i, 7-g, 8-c **V.** 1. These people are nearsighted. 2. Motion pictures must have 24 frames per second in order to make motion seem continuous. 3. Your pupils are wide-open and too much light enters your eyes causing a temporary "blindness." 4. If you suffer from red-green color blindness, you can get a driver's license but you are cautioned to look for position and shape rather than color of the signs. 5. Your mind (brain) retains the picture. **VI.** 1, 2 and 3 may be demonstrated or reported to the class. **VII.** Report to class.

**Chapter 14**

**I.** 1, 3 **II.** 1. The image is erect, same size as the object and reversed (left side in object appears on right side in image). 2. Rough surfaces diffuse light. They are poor reflectors. 3. Diffused reflection scatters the rays of light. 4. Yes. Shiny surfaces are very good reflectors of light. **III.** 1-b, 2-a, 3-a, 4-d **IV.** 1. AB 2. hits 3. angles 4. to get a beam of light **V.** Wind, EnERgy, VIrTual, reflEction, nOrmal, DarkNesS–STEVIE WONDER

**Chapter 15**

**I.** 2, 4 **II.** 1-3, 2-4, 3-6, 4-7 **III.** 1-d, 2-b, 3-a, 4-c **IV.** 1. true 2. true 3. makes smaller 4. concave **V.** 1. The angle of reflection is equal to the angle of incidence. 2. So that there will be no "glare" from the walls. 3. It has a concave mirror which is deep and reflects the beam far ahead on the road. **VI.** 1. slower 2. vacuum 3. stimulus, response 4. pitch 5. photons 6. sun, photosynthesis

**Chapter 16**

**I.** 2, 3 **II.** 1-6, 2-6, 3-4, 4-5 **III.** 1-c, 2-a, 3-b, 4-b **IV.** 1. optician 2. not real 3. convex 4. 300 000 km/s 5. reflect 6. concave **V.** Take Polaroid pictures of these experiments and project them on a screen by means of an opaque projector. **VI.** Display to class. **VII.** Display to class.

**Chapter 17**

**I.** 2, 4 **II.** 1. A refracting telescope uses a convex lens. 2. The lens of the eye is convex and inverts the object. 3. an inverted or upside down image 4. The projector uses a convex lens which inverts the upside down object to project an upside up image. **III.** 1-a, 2-d, 3-a, 4-b **IV.** 1. False. The lenses of the microscope help the eye. 2. True. They contain prisms which turn the image upside up. 3. True. They can see well, close-up. 4. False. It is changed from more to less convex or from less to more convex. **V.** 1. contact 2. stage 3. plane 4. eardrum **VI.** 1. A 20/20 vision means that you can see an object clearly at a distance of 20 feet. 2. Most lenses here are in either plane or double convex. 3. Most lenses here are either plane or double convex. 4. A convex lens will enlarge the words. A concave lens will make the words appear smaller.

### Chapter 18

**I.** 1, 3 **II.** 1-7, 2-8, 3-5, 4-6 **III.** 1-b, 2-b, 3-a, 4-b **IV.** 1. We darken the room so that no other light may enter. 2. We use different colors to make certain that only the color of the opaque object is reflected. 3. The experiment proves that opaque objects absorb all colors except the one it reflects. 4. Yes. The color of the paint is the same color that it reflects. 5. Yes, but now the color of the glass is the same as the color it reflects or transmits. **V.** 1. true 2. blue 3. true 4. red 5. true **VI.** Show to the class.

### Chapter 19

**I.** 2, 4 **II.** 1-5, 2-7, 3-6, 4-3 **III.** 1-b, 2-d, 3-b, 4-d **IV.** 1. True. Ultra-violet light cannot be seen but fluorescent light will shine in this light. 2. False. Radio waves are very long waves. 3. False. It is the trough. 4. False. It has to be done with an X-ray machine. **V.** 1-d, 2-a, 3-b, 4-e **VI.** 1. Yes. Yes. 2. Report to the class on your findings. **VII.** 1. special vacuum tubes which produce waves 2. a device for tuning a radio or TV 3. picks up electromagnetic waves 4. changes sound waves to electromagnetic waves

### Chapter 20

**I.** 2, 4 **II.** 1-5, 2-7, 3-4, 4-2 **III.** 1-a, 2-b, 3-b, 4-b or d **IV.** 1-d, 2-i, 3-a, 4-e, 5-h, 6-c, 7-g, 8-j **V.** 1. False. A fluorescent bulb uses mercury rays to strike the phosphor. 2. False. The light comes from the filament being heated to incandescence. 3. False. It is filled with nitrogen or argon gas.

### Chapter 21

**I.** 1, 3 **II.** 1-5, 2-3, 3-7, 4-6 **III.** 1-a, 2-a, 3-c, 4-c **IV.** 1. Chemical. A new color is formed. 2. It could have been stopped by keeping the light away. 3. Yes, by doing the experiment using red cellophane and a control. 4. Yes, by doing the experiment using different time controls. **V.** 1. negative 2. silver bromide 3. makes the image clearer 4. 16 5. a convex lens **VI.** 1. Kinescope—a picture tube or a record of a TV picture on film. Speaker—a device for changing electromagnetic waves to sound waves. 2. Picture tube—the device in which an electromagnetic wave becomes a picture. Vacuum Tube—a device used for receiving or sending electromagnetic waves. 3. Transistor—a device which is used instead of a vacuum tube to amplify electromagnetic signals. Transmitter—an antenna for sending electromagnetic signals.

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